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Electrical World

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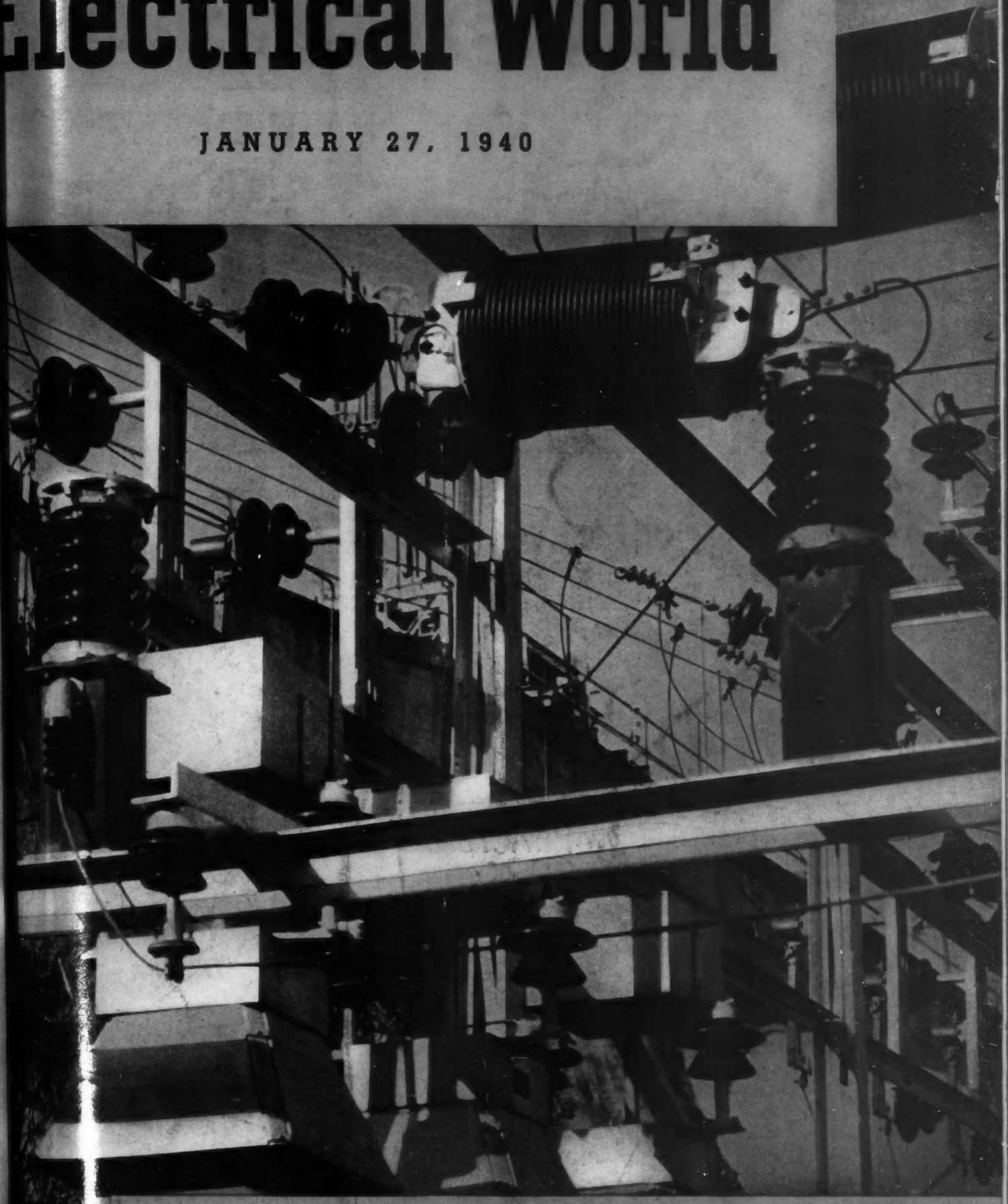

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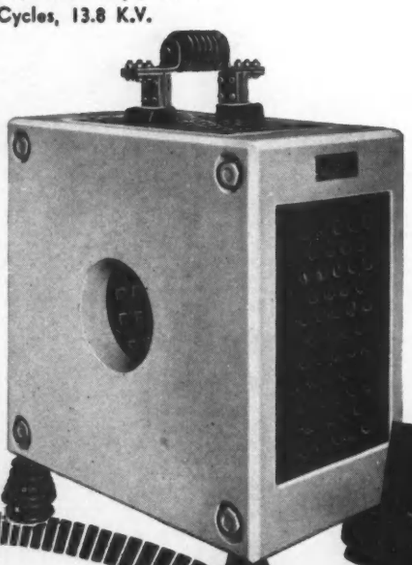

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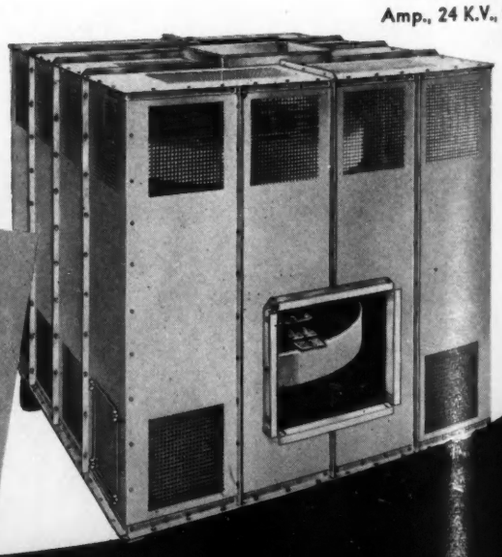

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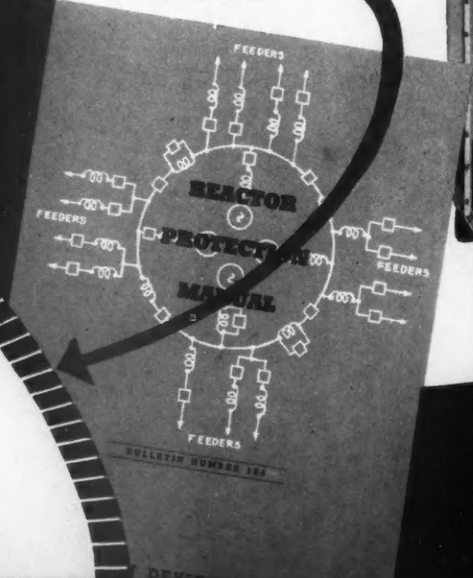

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A History Needed

There is no written history of the electrical industry. Not a year goes by, however, but what we receive a number of requests for information that would have been found in a reliable history were it available. The questions are not ones merely of academic interest. To secure the answers people go to no end of trouble and expense.

When the time capsule was put together for burial at the New York World's Fair no history of our industry could be found. There is, however, under preparation a history of the electric utility industry, but that, naturally, can cover but a part of the complete story of electricity.

What has been the course of electrical engineering, of design, of generation, of utilization, of construction? We have had a history of lighting, but what of transformers, of motors, or protection, or all the host of things that go to make up our equipment side?

Why have a history? The answer, it seems to us, should be obvious. Only a few men are living today who saw the beginnings of commercial electricity. Each year brings new talent to us. These new men need to know what has happened in the past as a guide to their future activities.

Our history did not just happen. There were reasons for everything that was done. Trends were set up and they dictated the path of progress. We need to know these trends to keep from going back over ground that has already been adequately explored, to keep from making the same errors that long ago were proven uneconomic.

We need our history to stimulate the young students who shortly will be working in the industry. They have little knowledge from their textbooks as to what constitutes this industry, or what it has accomplished, or how.

We need a history to reconfirm our own faith in this industry we serve. We need to see that all the progress was not made before the World War, that greater things are being done today than the men of 1914 ever dreamed of, that the opportunity for further development is the greatest today it ever has been, and will be greater tomorrow.

Fortunately, whoever undertakes to compile such a history will find a wealth of material quickly available. Since the beginning the industry has had its journals to record the progress of the art, and early it had its associations, the proceedings of which are primary. It also has several manufacturing companies that started in the pioneer years. And, finally, there are some men who go back to the beginning, or nearly so, whose memories are storehouses of early developments. And unless we act quickly many of these minds will be stilled forever and the loss will never be recoverable.

Low-Cost Single-Unit Plant for Kansas Utility

Windowless plant has controlled ventilation — Location of auxiliaries on same floor with boiler and turbine operating aisles makes operation simple — Circulating water pumps in crib house avoid expensive tunnel design

GEORGE A. MILLS,* ***Formerly President Kansas Electric Power Company, Lawrence, Kan.***

LAST SPRING saw the first operation on the system of the Kansas Electric Power Company of a new 10,000-kw. single-unit steam power plant which combines construction and operating economy with several novel design features. The main plant building is windowless and controlled ventilation and modern lighting insure the comfort of the operators. By eliminating the usual curtain wall, the turbine and boiler room are thrown together, utilizing a minimum of space. This arrangement, coupled with the fact that most of the station auxiliaries are on the main floor, simplifies operation and centralizes control. Natural gas is used as fuel, with oil as standby, but provision is made in the building and equipment for the addition of coal handling and pulverizing equipment should a change to this fuel be advisable.

A Base Load Plant

The new station, which was designed and engineered by Sargent & Lundy, Inc., Chicago, is located on the Kansas River 3½ miles upstream from Lawrence, where it is assured condensing water sufficient for the planned ultimate capacity of 60,000 kw. even during low-flow periods. Designed for a load factor of 50 to 60 per cent using fuel at 14 cents per million B.t.u., the station will operate as a base-load unit, bringing the capacity of this integrated system in eastern Kansas to 28,400 kw.

Future needs of the system may be met by the addition of a second 10,000-kw. unit and possibly two 20,000-kw. units to this plant, bringing it to the ultimate design capacity.

The initial 10,000-kw. unit is a 3,600-r.p.m., single-cylinder General Electric turbo-generator with four-point extraction for feed-water heating. The turbine operates on steam at 650 lb. pressure and 825 deg. F. total temperature, supplied from two Foster-Wheeler bent-tube boilers of 60,000 lb. per hour steaming capacity, having 5,230 sq.ft. of heating surface.

This steam pressure and temperature was selected because it gave the lowest combined fixed and operating cost. Adoption of a higher steam pressure for this size turbine would increase the operating problems. The fuel saving which would have been obtained by an increase in pressure was not sufficient to justify the additional cost for turbine and boiler equipment. It is interesting to note in passing that this pressure and temperature was selected *before* the National Defense Power Committee recommended it for 10,000-kw. turbines.

As shown in an accompanying diagram, the heat balance is arranged with a deaerating heater, which insures oxygen free condensate under all operating conditions and also supplies storage capacity for the boiler feed pumps. It is felt that such an arrangement is advantageous for this size of equipment. It will also be noted from the diagram that the feedwater is heated in four stages to a total temperature of approximately 374 deg., to results in a low heat rate.

The station heat rate is 13,766 B.t.u. per kilowatt-hour send-out at full load and 15,000 B.t.u. per kilowatt-hour at half load, corresponding to thermal efficiencies of 24.8 and 22.61 per cent respectively. Various station auxiliaries and mechanical equipment, with the exception of one of the three 290-g.p.m., 3,550-r.p.m. boiler feed pumps, are electrically driven and have a motor capacity of 1,073¾ hp.

Plant building and equipment were originally laid out for use of powdered fuel costing 14 cents per million B.t.u. However, due to a favorable off-peak natural gas contract, gas was selected for the initial fuel. with oil, for which a 28,000-bbl. storage tank is provided, as standby. If, in the future, it proves desirable to use coal as fuel, this may be done by adding unit pulverizing mills and a conveyor system.

Gas More Economical

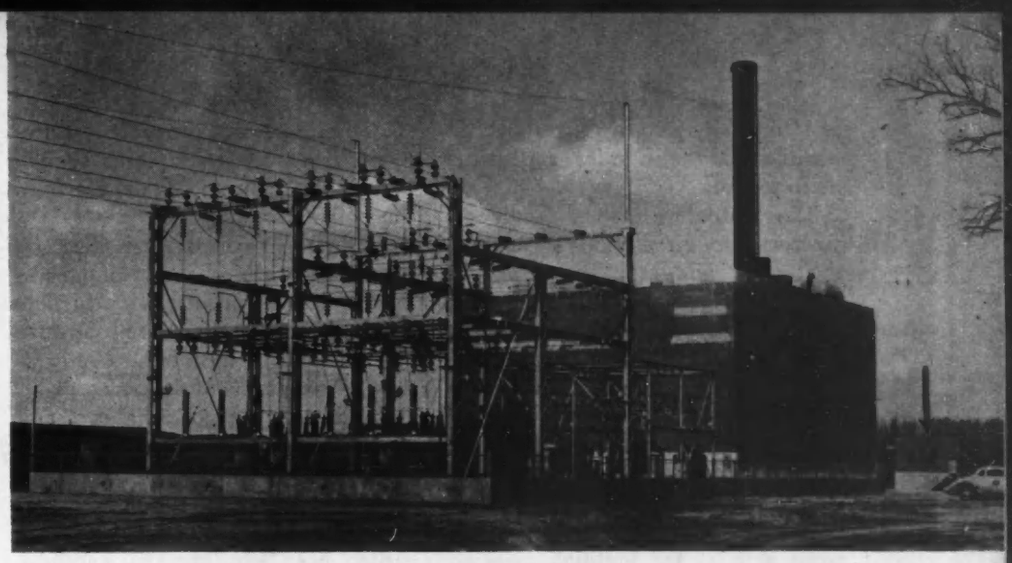
Because of the extensive use of gas for industrial purposes, mine-run coal would have to be used the greater part of the year from the strip mines in southeastern Kansas. This would result in a price of coal delivered on the present basis which would be more expensive than gas. Furthermore, gas makes for cleanliness and superior operating conditions.

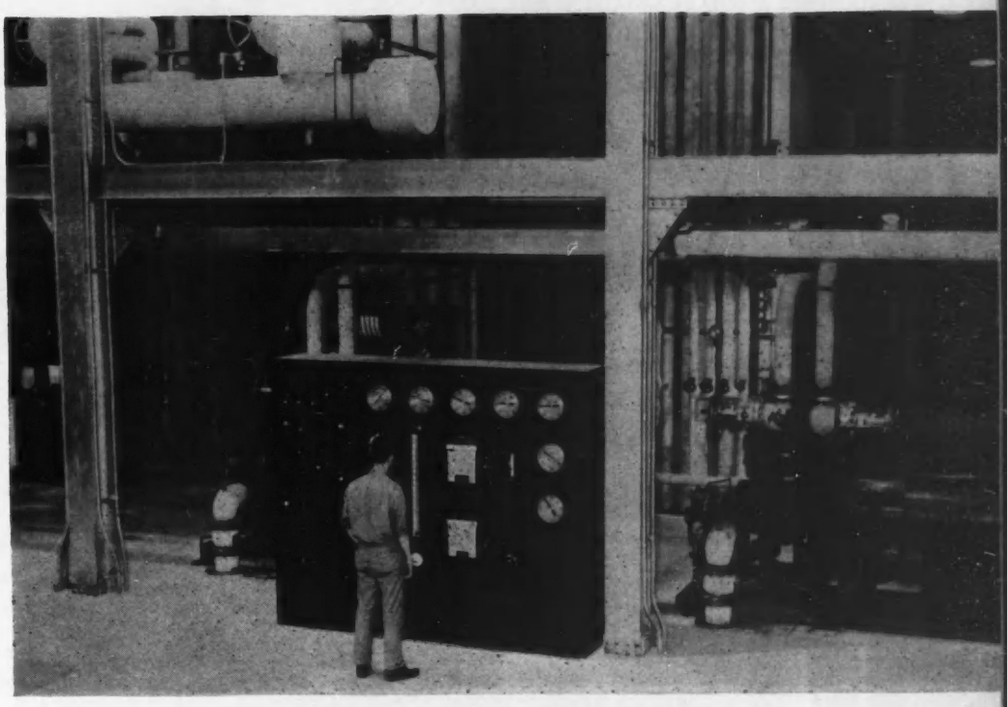
Space in the building was conserved and operation centralized and considerably simplified by elimination of the usual curtain wall between boiler and turbine rooms and the arrangement of turbine and boiler operating aisles adjacent. Principal plant auxiliaries, with the exception of the Foster-Wheeler circulating water pumps, which are located in the crib house, are on the operating floor. This further tends to simplify operation in a small station such as

* Mr. Mills, since preparing this article, has become connected with Central Power & Light Company, Corpus Christi, Texas.

this, since operators are at all times within a few feet of all vital station equipment. Volume of the plant building is 49,500 cu.ft. On a per kilowatt basis the volume of the various building sections are: Boiler room, 20.9 cu.ft. per kilowatt; turbine room, 15.9 cu.ft. per kilowatt; machine shop, 5.7 cu.ft. per kilowatt (the machine shop was larger than would be expected to provide for future expansion); offices and storage battery rooms, 3.4 cu.ft. per kilowatt.

One of the main reasons why the circulating pumps were located in the crib house, as mentioned above, is that there is considerable distance between the crib house and the main building, and if the pumps had been located in the main building it would have been necessary to use an expen-





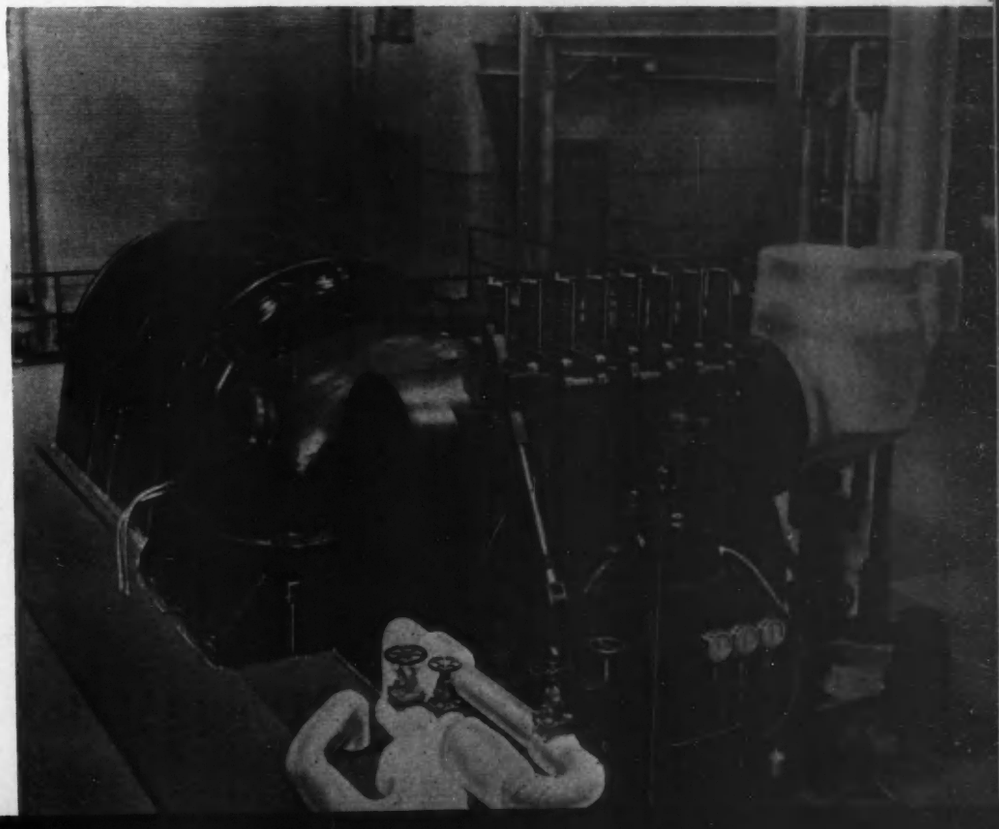
Generator and high-voltage buses are located in outdoor substation protected by overhead ground wires. Two 66-kw. lines emanate from station. Arrow indicates intake crib on bank of Kansas River (above)

Absence of curtain wall between turbine and boiler room, proximity of turbine and boiler operating aisles and location of fans and other auxiliaries on one floor centralizes and simplifies operation (center). This is boiler control board.

Initial 10,000-kw. unit at Lawrence station (below)

sive tunnel design. With the arrangement used the discharge pipe from the pumps is under pressure and is located at a much higher elevation than the tunnel could be, with consequent reduction in first cost.

A departure in power plant design was the elimination of windows in the main plant building. A special ventilating system controls air circulation through the building. The windowless building idea originated in an attempt to eliminate unsightly window conditions resulting from dust and to reduce the usually high maintenance and cleaning cost arising from inaccessibility. Glass brick was considered, but the designers were led to the idea of eliminating all windows, substituting a controlled air flow and modern building lighting. It was reasoned that operators would spend at least 50 per cent of their time under artificial light even if windows were provided. With proper artificial lighting controlled



as to intensity in operating areas, the plant would be a safer and better place to work.

The ventilating system provides a positive air circulation throughout the entire building. To purge the condenser pit and basement, normally pocketed with air, a louver opening is provided on the south side of the building and connected to an air-conditioning unit with two double inlet fans belted to a 3-hp. motor capable of delivering 6,000 cu.ft. per minute against 1¼ in. static pressure. Large louvers are provided on the north side of the building back of the boilers and in the basement under the boilers. Air movement is induced by three fan-driven ventilators on the roof of the building just over the boilers. These three ventilators are 54-in. stationary type, in which is installed a 50-in. aluminum blade fan driven with an 850-r.p.m., 10-hp. motor. Sufficient air is circulated to take off the boiler room heat.

Ventilator fans are equipped with reversible motors so that the fans may be reversed in the winter, thus spreading heat from the boilers into the operating areas for warmth. While the plant has not been operated for a complete winter cycle, the experience with the arrangement this year indicated that the scheme of heating will be perfectly satisfactory. No other heat arrangements are provided. The forced-draft fans supplying air to the furnaces take air from the boiler room.

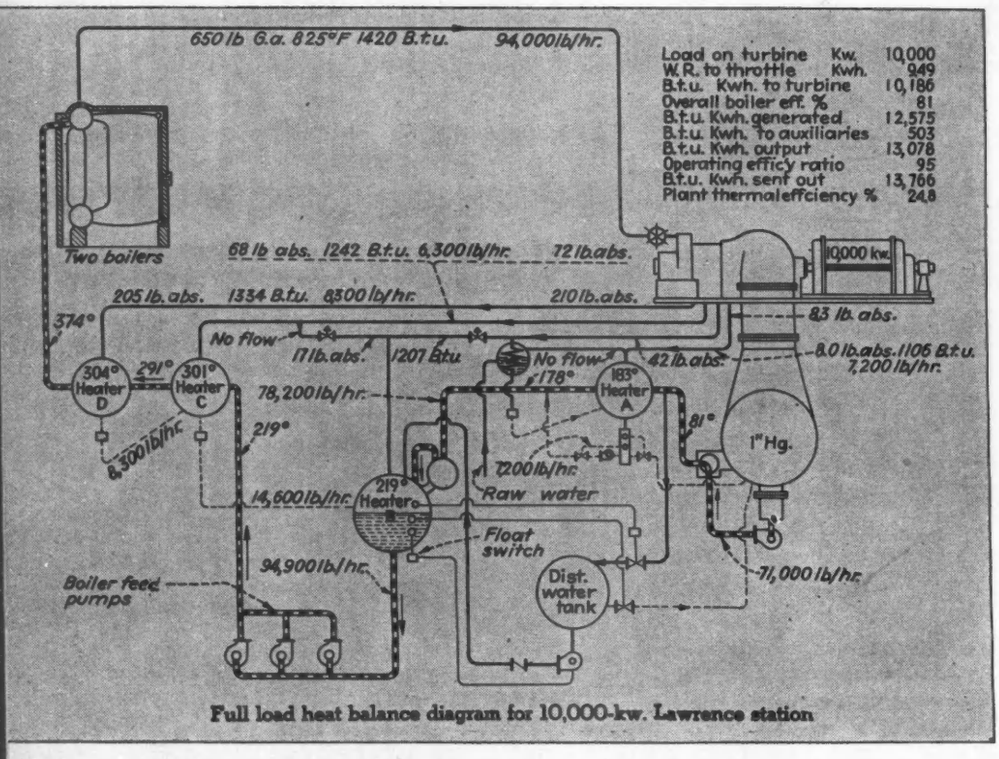
As to the psychological effect on employees working in a windowless power plant, it is interesting to note that operators have made no adverse comment about the absence of windows. The volume of the power plant, coupled with the good lighting and the pleasant atmosphere created by air conditioning, has had such an effect upon those in the building that they do not look for windows. This matter has been checked carefully with employees in an indirect manner, so that the employees did not answer directly to an official of the company, and it was found that the employees are very happy with the arrangement.

Since the plant is operated under artificial light at all times, a light buff glazed brick was used for the interior walls, light terrazzo floors were installed and the ceiling has been painted to reflect light efficiently. Standard commercial lighting units were selected to deliver 20-ft.-candles on the main operating floor. Supplemental lighting is well arranged to illuminate operating centers which are shaded by catwalks and equipments.

The unit cost of the complete station of $135.51 per kilowatt, including grounds, landscaping, trackage and substation, is not of particular significance as an indication of cost economy inasmuch as the initial outlay includes facilities and equipment to be utilized in future expansion, particularly condenser water supply facilities. An extra large crib house was constructed and provided with circulating water screens for two units.

Location of the plant building on a side hill made further construction economy possible since a minimum of excavation was necessary for the condenser pit and footing. It allowed the basement walls to be built above the natural ground level. After the basement was completed material was moved from the adjacent bluff, filling around the basement on three sides about 20 ft. above the natural ground level. This created an approach from the high land to the station above the maximum floodwater level and resulted in a much lower cost than if the plant had been built on high elevation ground.

The station is designed to be proof against floodwaters up to 32.7 ft. above normal river level. This provides a margin of 9 ft. above the highest water level on record, which is 23.7 ft. above normal river level and was attained in 1903.

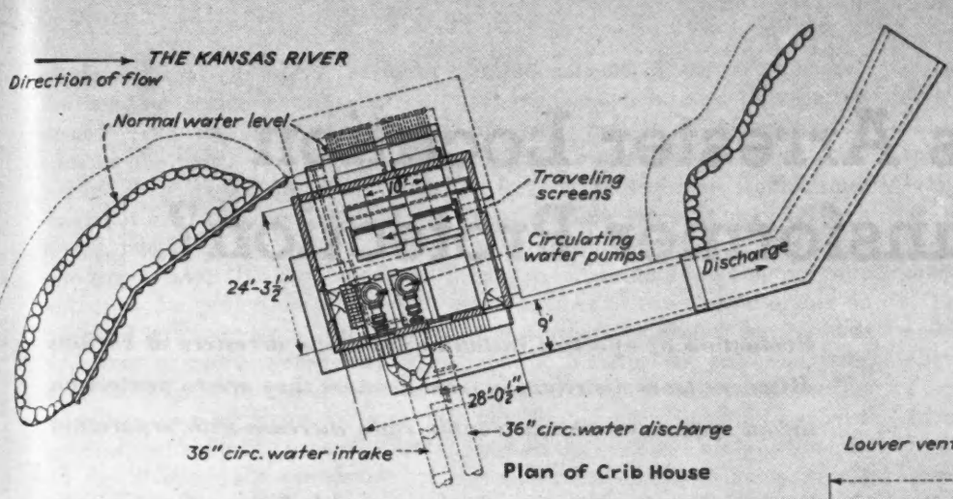


Full load heat balance diagram for 10,000-kw. Lawrence station

Substation

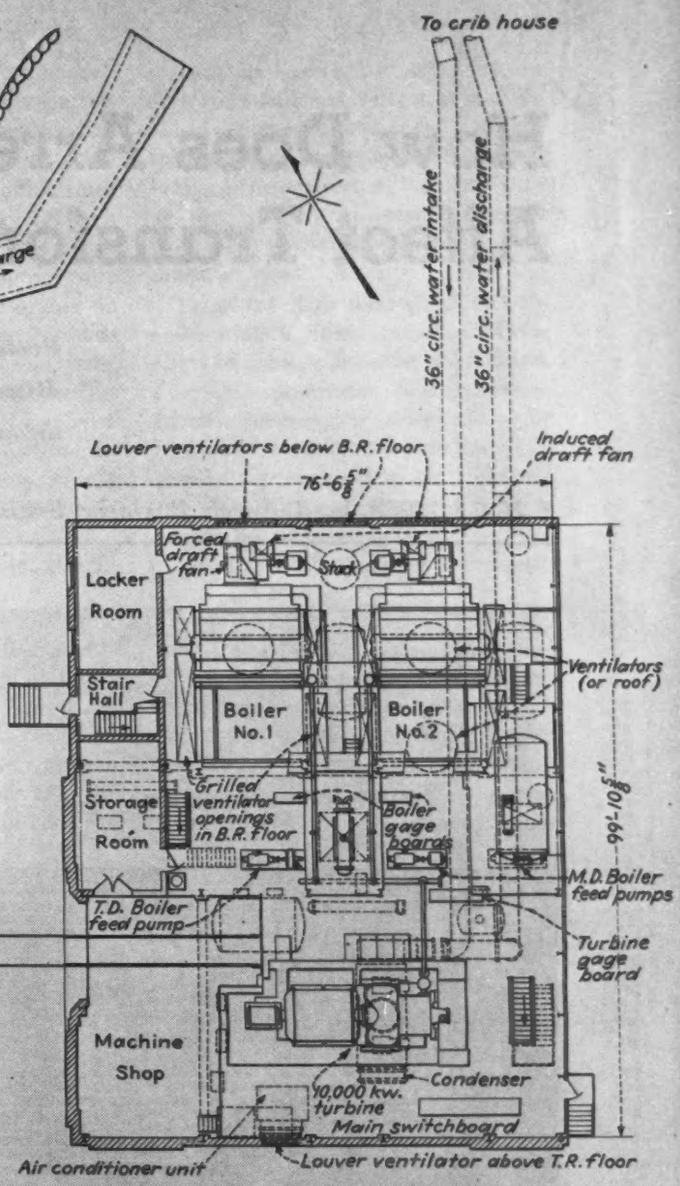
Output of the 10,000-kw., 13,800-volt, 60-cycle, three-phase generator is connected to the 13.8-kv. main bus, which is located in the outdoor substation, through an oil circuit breaker. This 13.8-kv. outdoor main bus is laid out so that a 13.8-kv. transfer bus can be added in case additional feeders are required at greater voltage. From the main bus taps are taken off to the primary of a 12,500-volt, 13.8 to 69-kv., self-cooled main transformer. The secondary or high-voltage side of the transformer is connected through an oil circuit breaker to the 69-kv. main bus. A 69-kv. circuit breaker is also provided for each of the two 66-kv. outgoing lines to Lawrence and Emporia that tap the main bus through a transfer bus arrangement.

Two 1,000-kva, three-phase, 13.8-kv. to 460-volt main and reserve auxiliary transformers are provided to supply the plant's electrically driven auxiliaries.



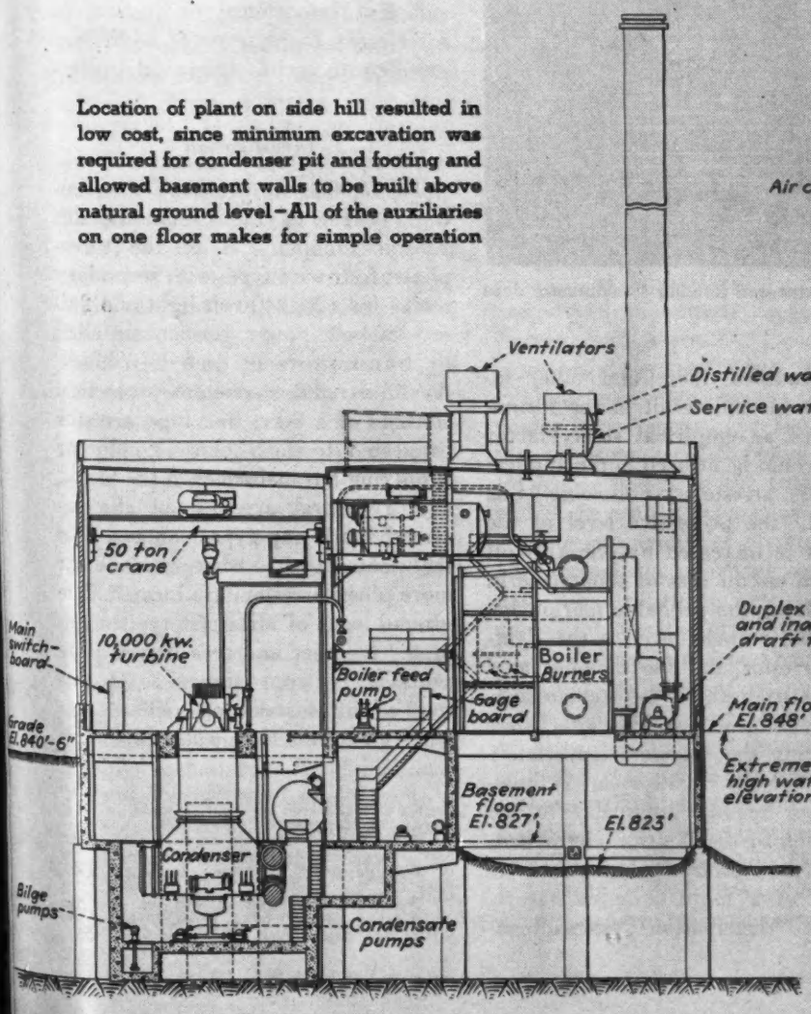
Plan of Crib House

Locating circulating water pumps in the crib house avoided construction of a long and costly intake tunnel

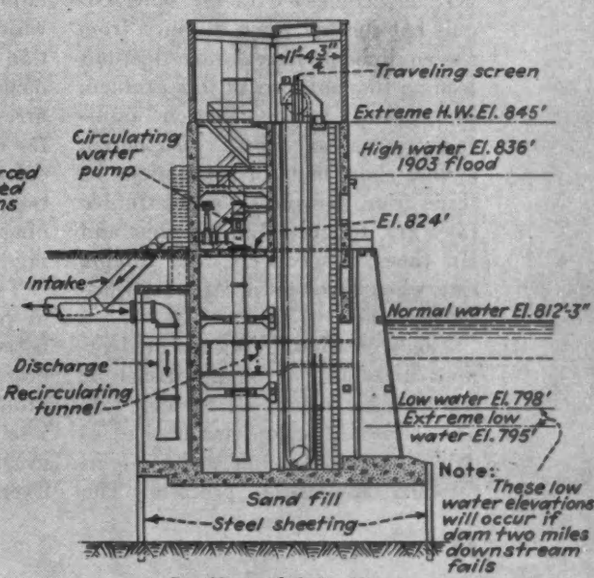


Plan of Power Station

Location of plant on side hill resulted in low cost, since minimum excavation was required for condenser pit and footing and allowed basement walls to be built above natural ground level—All of the auxiliaries on one floor makes for simple operation



Section of Power Station



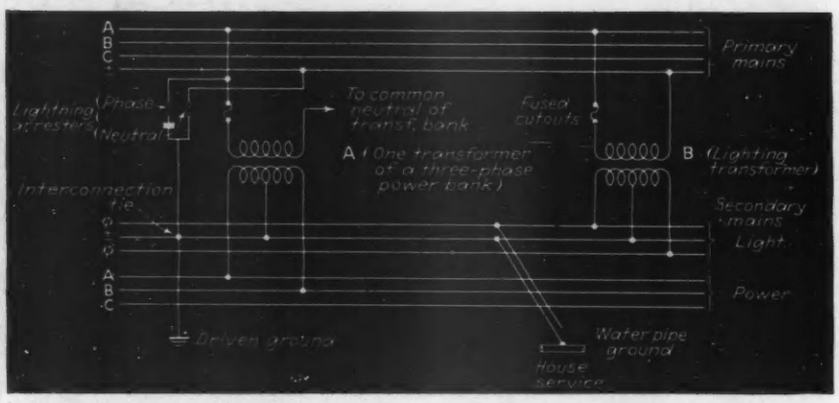
Section of Crib House

How Does Arrester Location Affect Transformer Protection?

Evaluation of effect of installing lightning arresters at various distances from distribution transformers they are to protect on urban systems — Shows trouble rates increase with separation

E. H. GROSSER, Jr., *Research Engineer Engineering Department, Commonwealth Edison Co., Chicago*

IN THE protection of transformers and other electrical equipment from the damaging effects of lightning it has been recognized for several years that, for maximum effectiveness, the lightning arrester should be located as near as possible to the equipment to be protected. No information, however, has been available concerning the degree of protection offered by arresters connected to the same circuit but located some distance from the equipment. Recent investigations leading to a solution of this problem as applied to distribution transformers on an urban distribution system show that for separations of three, four, five and six spans trouble rates are, roughly, 1.5, 2.5, four and six times, respectively, the trouble rate when arresters are at the transformer pole.



Use of a single set of lightning arresters for both power and lighting transformers does not afford equal protection to both

The protection, by means of lightning arresters, of single banks of transformers connected to high-voltage overhead transmission lines is today a relatively simple and straightforward application problem. The effect of separation between transformer and arrester, in this type of installation, has been investigated by tests using the surge generator[1] and theoretical analyses of traveling wave phenomena.[2] Although such studies have not shown the effect of arrester location on the frequency of lightning troubles, these and other investigations did result in the formulation of an empirical safety factor which could be utilized in the application of arresters. Following this method,[3] the protective level of the arrester is increased by one kilovolt for each circuit foot of separation in determining the probable margin between the voltage level of the lightning arrester and the demonstrated impulse strength of the transformer.

This solution, or the alternative of placing the arrester immediately adjacent to the transformer, is, however, not readily applicable to the protection of distribution equipment, where the protective problem is usually of a more complex nature. Overhead distribution systems ordinarily contain groups of transformers, supplying both power and light services, which may, for economic reasons, be dependent upon a single set of arresters. Obviously, if these transformers are separated by several spans the arresters must be nearer to some than to others, and differences in the protective value of the arresters might be expected for the several transformers. The problem is, therefore, whether a protective differential exists, how great it is, and if it is of sufficient importance to justify, in some cases, the expense of additional arresters to secure improved protection.

Investigation

The 4,000-volt overhead distribution system of the Commonwealth Edison Company is of the three-phase, four-wire type, with secondary mains for 120/240-volt light and 240 or 480-volt power service supplied by transformers in each city block. As illustrated, arrester protection consists of a 3-kv. line type arrester connected to each phase conductor supplying a transformer in the block, and a neutral arrester, of the inclosed spark gap type, connected to the neutral wire wherever one or more phase arresters are located. The ground leads of all arresters are connected together and to a driven pipe ground. In approximately 92 per cent of all installations where secondary neutrals have water pipe con-

[1] "Field Tests on Thyrite Lightning Arresters," by K. B. McEachron and E. J. Wade, *A.I.E.E. Trans.*, Vol. 50, June, 1931, page 479.

[2] "Protection of Stations Against Lightning," Part II: Lightning Arresters; by L. V. Bewley and W. J. Rudge, Jr., *G. E. Review*, September, 1937, page 429.

[3] "Application of Arresters and the Selection of Insulation Levels," by J. H. Foote and J. R. North, *Elec. Engg.*, June, 1937, page 677.

nections inside customers' premises the arrester grounds are interconnected[4] with the secondary neutral wire on the pole.

Fig. 1 shows the situation which exists for more than one-fourth of the transformers on the system, where one transformer (B) may be dependent upon the protection afforded by a set of arresters at a transformer (A) one or more spans away. For such cases impulse voltages between windings due to lightning are, in general, limited to the protective level of the arresters for transformer A, but at transformer B the potential may be increased due to the travel of steep-fronted lightning surges along the primary mains. This was shown by measurements of potentials at these points during lightning storms in the past three years, using surge voltage recorders connected between the primary phase wire and secondary neutral.

Impulse voltages across the arrester terminals and between transformer windings were substantially the same where they were on the same pole, but where arrester and transformer were separated by one to three spans the voltage across the transformer was as much as 40 kv. higher in several instances. Thus, for transformers dependent for protection upon arresters one or more spans away fuse blowings and transformer failures due to lightning might be expected to occur at a higher rate than for transformers with adjacent arresters.

Following this line of reasoning, a statistical investigation of lightning troubles on the distribution system had been started in 1932, to secure data regarding the location of the arrester with respect to the transformer in each case of lightning trouble. In the first few years of the study the data did not produce usable results, since the interconnection of arrester grounds and secondary neutral mains, starting in 1932, had not yet been applied to many transformers. For the older so-called "standard" method of protection, with arresters connected to only a single-driven ground rod, it was found that the random location of grounds on the secondary neutral mains influenced transformer protection to an erratic and obscure extent. A considerable amount of data was needed for reliable conclusions. Only during the past year were adequate data available for such an analysis.

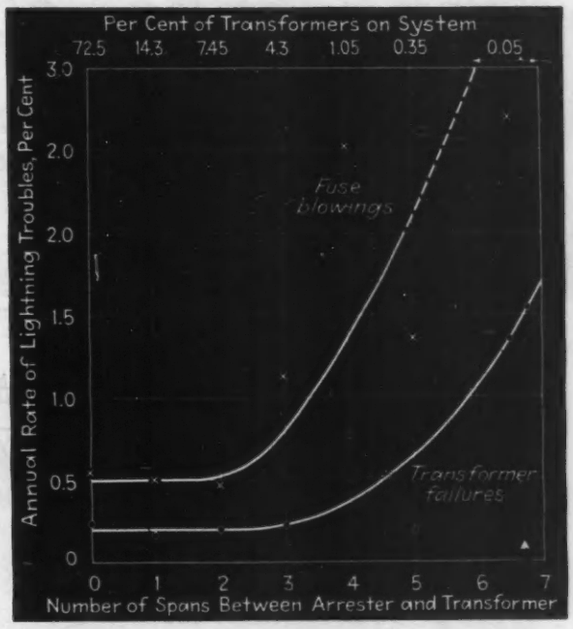
In order to determine trouble rates for various separations between transformer and arrester it was necessary to obtain data covering not only the number of troubles occurring on transformers protected by arresters at the transformer and one, two, three, etc., spans away, but also the numbers of such installations existing on the system. This was done by a map count of the various groups in typical areas, comprising about 10 per cent of the city area.

Using these data, the annual rates of transformer failures and fuse blowings due to lightning, during the seven years of the investigation, were calculated. These data comprise totals of 336 transformer failures and 860 fuse blowings occurring in almost 150,000 transformer-years of operation and are, therefore, considered dependable for the purpose of this analysis.

The results of this statistical study, shown in full in Fig. 2, confirm the theoretical analyses by showing definite increases in failures and fuse blowing rates as the separation between transformer and arrester increases. They go further, however, in indicating two factors of particular importance: First, the finding that no protective differential existed between arresters at the transformer and those with a separation not exceeding two spans, or about 200 ft., and, second, the provision of specific data upon which to base economic studies of arrester protection.

Fig. 2 shows a constant rate of fuse blowings for separations up to two spans and of transformer failures up to three spans. From this, analysis indicates that, on urban distribution systems well shielded by surrounding buildings, the characteristics of incident lightning surges probably do not, in general, include wave fronts shorter than about one-half microsecond. For systems in open rural territory, or even for suburban systems, it is probable that steeper and higher voltage surges occur; hence, on such systems, locating the arrester at the same pole as the distribution transformer is probably more essential than on urban systems.

From the data secured in this investigation a direct measure of the effect of arrester location is available. For this particular system transformers protected by arresters one or two spans away would have approximately the same rates of lightning troubles as transformers with adjacent arrester protection. For separations of three, four, five and six spans relative trouble rates would be roughly 1.5, 2.5, four and six, respectively, based on a trouble rate of unity where arresters are located at the transformer pole. On this same basis relative trouble rates of ten or higher would be expected if no arresters were used. As applied to other systems, particularly those in rural territory, these data should be used with caution, but they should serve in a general way to evaluate the economics of arrester protection.



Lightning troubles increase sharply for arrester locations in excess of three spans from transformer. Data cover 1932 to 1938, inclusive

Using these data, an economic study of arrester protection on the Chicago distribution system has been made. The average annual rates of transformer failures and fuse blowings due to lightning during the past seven years were 0.23 and 0.59 per

[4] "Lightning Investigations on a Distribution System," by Herman Halperin and E. H. Grosser, Jr., *Elec. Engg.* (*A.I.E.E. Trans.*) January, 1936, page 63.

cent, respectively, with the interconnection method of protection. Although about 22 per cent of the 33,000 transformers on the overhead distribution system have arrester protection one or two spans away, less than 6 per cent are protected by arresters more than two spans distant. Thus the installation of additional arresters at these transformers would result in a reduction of only about ten transformer failures and 30 fuse blowings per year. The resultant saving in transformer and fuse replacements amounts to less than 50 per cent of the annual charges on the additional investment in lightning arresters. This study indicates that there is no economic justification at the present time for increasing the arrester density on this system.

For other systems having a larger proportion of transformers dependent upon arrester protection several spans away, or for rural or semi-rural systems, analysis and economic study may show additional arresters to be justified. The data presented here enable such analyses to be readily made and the most economical installation of lightning arresters to be selected.

Multi-Purpose Truck Is Ambassador of Good Will

Equipped to furnish light, power or public-address service, Pepco's unit has been kept busy — Intended as a construction service unit, its duties have increased — It is on hand for many an emergency

WALTER W. R. MAY, *Director Industrial Development, Portland General Electric Co., Portland, Ore.*

A MOBILE generating unit which Portland General Electric Company built two years ago to provide light for men working on de-energized lines at night has turned out to be a much bigger asset than was bargained for. It has generated not only power but a great deal of invaluable good will.

One stormy night a United Airlines transport landed at a new airport. Facilities for proper handling of air traffic had not yet been installed and the plane had to stand without engine covers until the storm cleared. In the morning the engines were so stiff they couldn't be turned over with batteries or by hand.

An auxiliary starter was sent to the scene by United Airlines and we dispatched our mobile truck to furnish power for the starter. A few minutes later the plane was on its way to Seattle.

That is just one instance in which the mobile unit—displaying the symbols "PEPCO—'At Your Service'"—has played a rôle which seems strange to the normal operation of an electric utility, but which is needed and appreciated in the community it serves and where emergencies are occurring all the time.

Besides power, the unit is capable of furnishing sound and light and thus gains a versatility which enables it to meet a variety of demands.

Built in the company garage with the aid of a local automobile body factory, it is one of two portable generating units operated by the company—the other being mounted on a trailer.

The generating unit proper consists of a 12½-kw., 240-volt, single-phase, a.c. generator with a direct-connected 800-watt exciter. This is mounted on a one-ton panel truck.

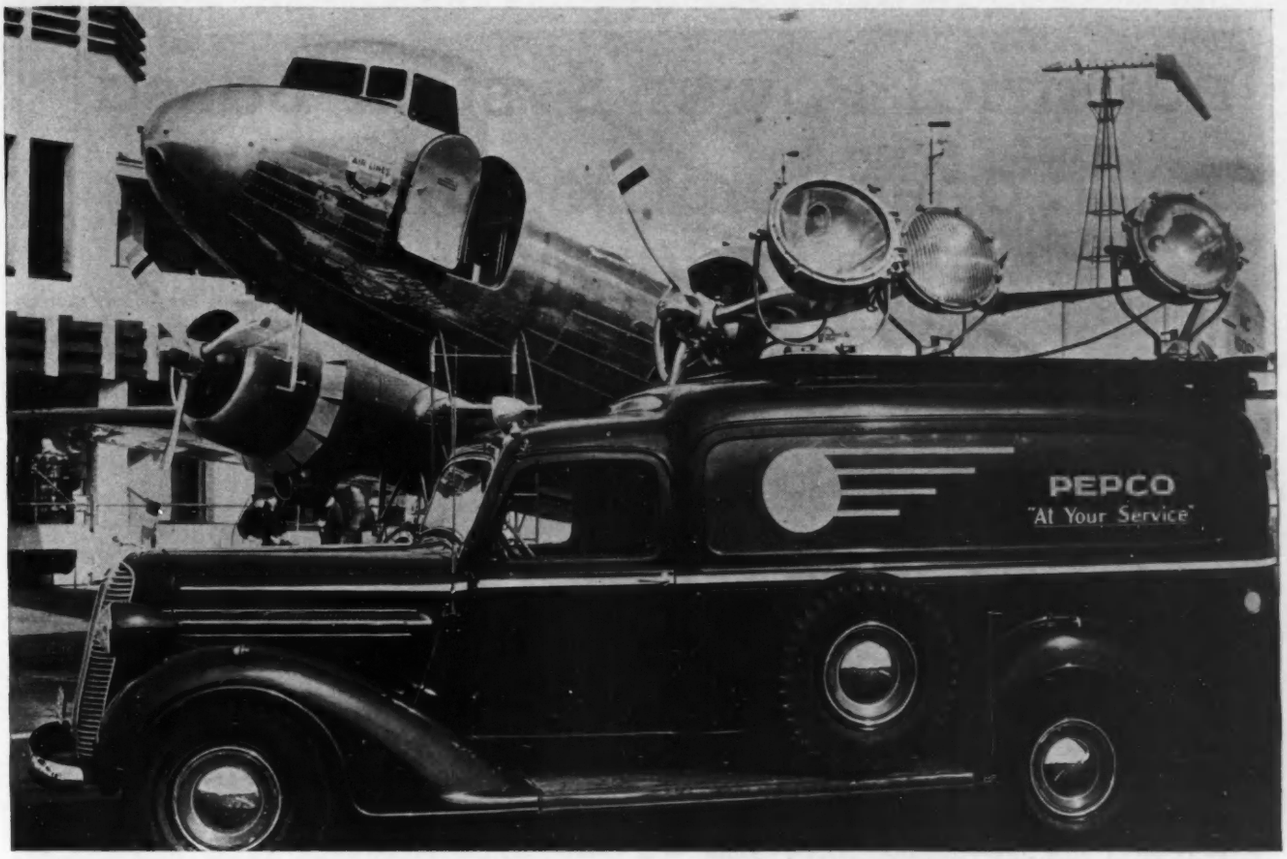
Power is taken by V-belts from the drive shaft and, when generating, the truck motor is regulated at 1,800 r.p.m. by a speed governor running from the generator shaft. This controls one of two butterfly valves in the truck-motor carburetor. The other is the one used when driving the truck.

An automatic regulator maintains any pre-set voltage up to 260 volts on a 15-kw. load. A 240-volt auto-transformer is center tapped to make 120-volt service available. A reel accommodating several hundred feet of three-wire cable is carried for making connection to the load.

When power loads are to be served a three-phase generator is towed behind, by means of a coupling provided for the purpose. To furnish light, especially for repair crews, three 19-in., 1,500-watt, spread-beam floodlights are carried on the roof.

On the night before the truck started United's transport on its way it was being used in connection with repair work occasioned by the same storm. A call was made upon it by a large fish hatchery near Wilwaukie, Ore. The truck sped to the hatchery and for four hours stood by furnishing power. Thus 80,000 fish eggs, which were in a critical stage of development, were saved.

On another occasion it was necessary to furnish 21 kw. of three-phase power for the transmitter of station KOIN and 8 kw. of single-phase power for lighting the transmitter room and tower. So well did the truck's regulating equipment perform that the service to the blinking lights was free from voltage surges, and in respect to three-phase power, the



One unique service was furnishing power to start an airliner, engines of which had frozen stiff in a storm

station operator was able to obtain 100 per cent modulation of his signal.

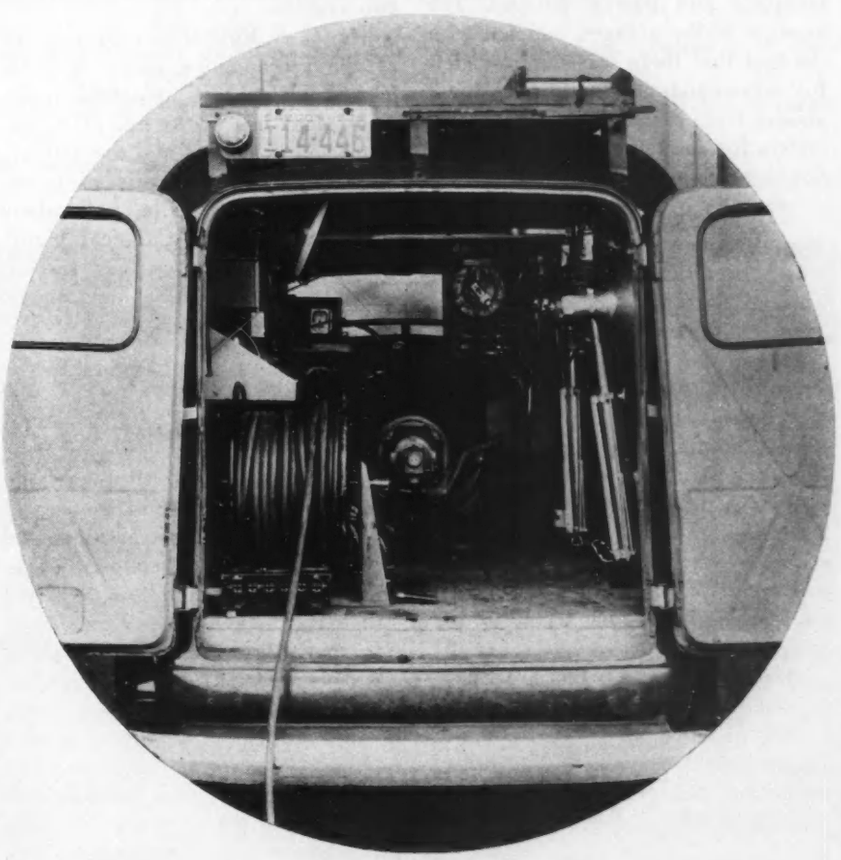
The unit received considerable publicity on the occasion of the dedication of the ski-lift at Timberline Lodge on the slopes of Mt. Hood, an event which was attended by Crown Prince Olav and Crown Princess Martha of Norway. Its mobility and its loud-speaker system, one of the finest public-address systems in Portland, enabled it to render a valuable service at the affair.

Since then it has been in such demand for county fairs and industrial-group picnics that the company has had to restrict its use to civic or public affairs staged with insufficient money to allow engaging a commercial sound truck.

The truck even qualified for a place in science's hall of fame when, by furnishing a number of different specified voltages in sequence, it enabled a Portland photographer to establish new data in connection with the development of color film.

During the filming of sound-motion pictures on electric water heating, cookery, irrigation pumping, etc., the truck is used to furnish photo-flood light for the pictures and

[*Continued on page* 96]



Inside are generator—driven by truck engine—regulating equipment, floodlights, public address, short-wave receiver. The reel of three-wire cable permits service to loads several hundred feet away

Industrial Power System Based on Co-operative Design

Utility and industrial engineers evolve reliable, flexible and efficient supply system for rubber products plant through co-operative design effort

T. F. OFFENBACKER,* ROSS PATRICK and HENRY T. FOX†

PREVIOUS to 1938 the 5,000-kva., 440-volt, step-down substation of the U. S. Rubber Company, Inc., at Indianapolis was supplied from a 33-kv. overhead transmission line, energized at both ends. Although means were provided on both sides of the tap-off point for sectionalizing this line in time of trouble, storms and other abnormal operating conditions frequently subjected the plant to complete and partial outages. The expense of the outages, coupled with the fact that there was no provision for accommodating additional load, arising from expansion, made a new system for receiving and distributing power necessary.

Getting Together

In designing a new power system work of the rubber company's engineers, experienced in industrial plant operation and maintenance, was coordinated with those of the Indianapolis Power & Light Company's engineers, familiar with substation design, construction and operating problems, to the end that an integrated industrial power supply system was evolved which, during its first year of operation, has given the best possible service to the rubber company.

Major features of the new service and distribution systems as evolved included: (1) Construction of a new 12,000-kva., 33/4.1-kv. utility substation to serve the rubber company and relieve local distribution circuits, (2) installation of three separate 4.1-kv. underground feeders from substation to industrial plant, any two of which would carry the plant's maximum load, (3) installation of new 4.1-kv. substation and distribution equipment at the industrial plant, (4) change-over of major part of motor load for this voltage, and (5) installation of a co-ordinated relay protection arrangement on the two systems.

The U. S. Rubber Company is one of the Indianapolis Power & Light Company's largest industrial loads. This plant has 6,845 hp. of 4.1-kv. synchronous motors and the 440-volt motors, consisting mostly of induction motors, normally pull about 1,200 kva. During a typical month maximum demand was 3,984.5 kw. at 100 per cent power factor and energy use was near 2,000 kw.-hr. From this the load factor was calculated to be 0.696.

New Substation

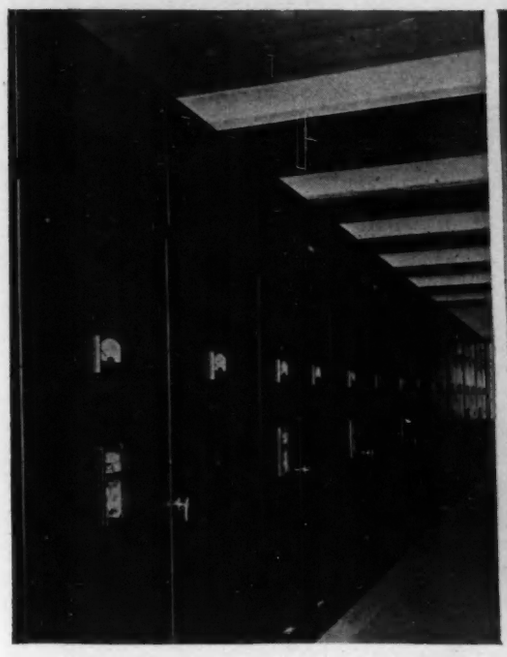
To provide the U. S. Rubber Company with a source of power of ample capacity for expansion and with good voltage regulation Indianapolis Power & Light Company constructed a new 12,000-kva. substation, No. 6, adjacent to the rubber company's property. This substation, built concurrently with modernization of the rubber company's service facilities, consists of two 6,000-kva., 33/4.1-kv. transformer banks, each normally tied together through a 4.1-kv. outdoor type metal-inclosed bus and tie breaker on the secondary side. On the primary side the two transformer banks are supplied from three sources. Two of the three 33-kv. supply lines originate from the company's southeast substation, which is connected through a 30,000-kva. bank to the 132-kv. loop. The third source is a 33-kv. underground cable connecting the substation directly with C. C. Perry K plant generating station of 52,000-kva. capacity. Normally only 15,000-kva. capacity of the C. C. Perry K plant feeds the southeast section, the other plant capacity being fed to the southwest section to the 132-kv. loop, but the two sections can be tied together at the plant for operation in cases of emergency.

Three separate 4.1-kv., 500,000-circ.mil underground cables, 1,152 ft. long, supply the rubber company's substation. Any two of the cables are large enough to carry the industrial plant load, but the three feeder cables insure service continuity in the case of damage to one cable. Provision has been made for a fourth cable to handle future load. The extra large feeder capacity, the proximity of the utility substation and its transformer capacity have operated to provide exceptionally good voltage regulation. Tests show that the voltage regulation at the rubber company's substation main bus is of the order of 1.8 per cent maximum. This regulation is practically the same as substation No. 6 regulation.

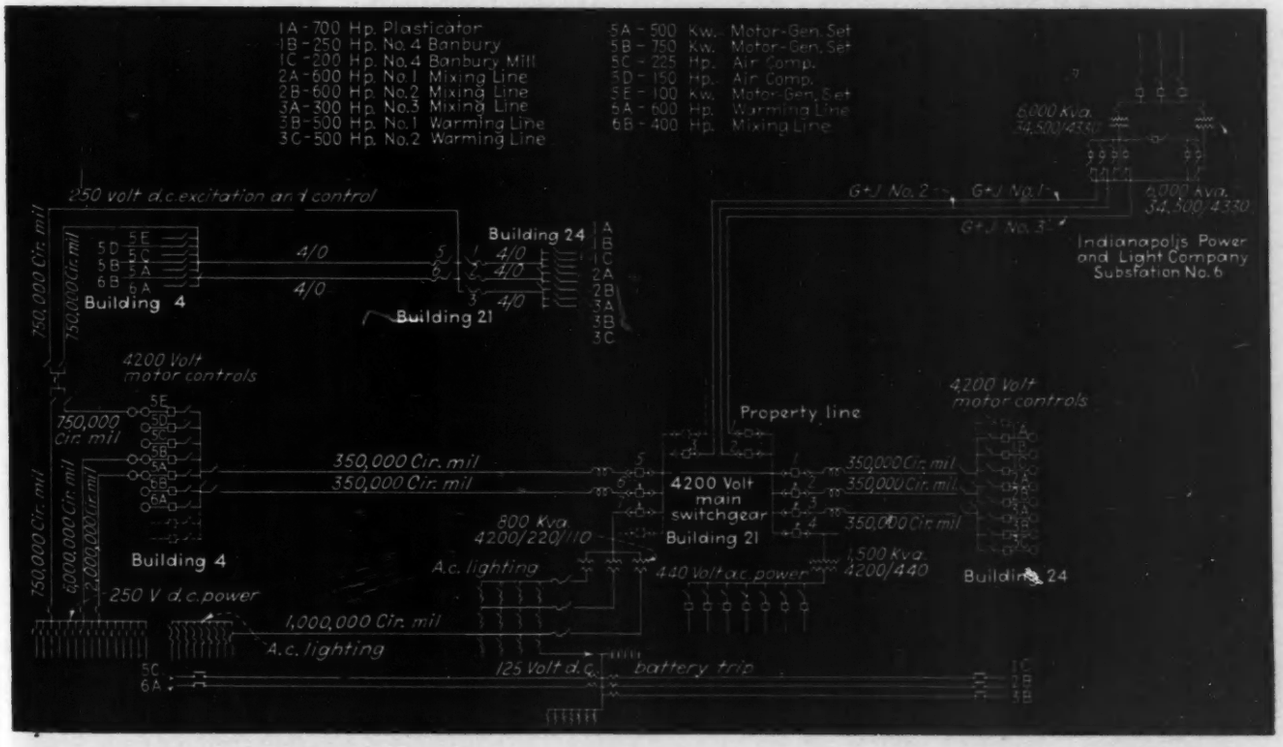
Plant Facilities

Under the old plant electrical system of 440 volts for all power loads, increase in connected capacity was difficult to handle, little improvement in operation could be obtained, motor

*Meter and relay department, Indianapolis Power & Light Company, Indianapolis, Ind.
† Plant engineer and chief electrician, respectively, U. S. Rubber Company, Inc., Indianapolis, Ind.



At the left, above, is the metal-inclosed switchboard for the 4.1-kv. plant power distribution circuits. Each cubicle contains oil circuit breaker, relays and control and other auxiliary equipment for the particular circuit. The other picture shows the main 4.1-kv. switchboard with which is included the 440-volt distribution occupying the four center panels. The two panels at the left side and the one at the right are for the three incoming feeders from the utility substation. Below is a diagram of the utility supply lines and of the distribution system to the various buildings of the Rubber company plant, with designations of feeders, motor locations and ratings


1A - 700 Hp. Plasticator
1B - 250 Hp. No. 4 Banbury
1C - 200 Hp. No. 4 Banbury Mill
2A - 600 Hp. No. 1 Mixing Line
2B - 600 Hp. No. 2 Mixing Line
3A - 300 Hp. No. 3 Mixing Line
3B - 500 Hp. No. 1 Warming Line
3C - 500 Hp. No. 2 Warming Line
5A - 500 Kw. Motor-Gen. Set
5B - 750 Kw. Motor-Gen. Set
5C - 225 Hp. Air Comp.
5D - 150 Hp. Air Comp.
5E - 100 Kw. Motor-Gen. Set
6A - 600 Hp. Warming Line
6B - 400 Hp. Mixing Line
6,000 Kva. 34,500/4330
G+J No. 2
G+J No. 1
G+J No. 3
Indianapolis Power and Light Company Substation No. 6
250 volt d.c. excitation and control
Building 24
Building 4
Building 21
4/0
750,000 Cir. mil
4200 Volt motor controls
Property line
350,000 Cir. mil
4200 Volt main switchgear
Building 21
800 Kva. 4200/220/110
A.c. lighting
440 Volt a.c. power
1,500 Kva. 4200/440
250 V d.c. power
1,000,000 Cir. mil
125 Volt d.c. battery trip

control was cumbersome and expensive, large copper was necessary at this voltage, continuity of service and safety to personnel and to machinery needed improvement and regulation on this voltage was a problem. In other words, the plant had outgrown the electrical system.

Aims of Co-operation

The objectives the U. S. Rubber Company's engineers had in mind when designing the new system are listed as follows, with the explanation of each:

A mixing mill, showing emergency stop cables that give operator complete remote control of synchronous mill motor equipped for dynamic braking

1. *Higher Voltage for Power Distribution and Large Motor Operation*—The voltage of 4.1 kv. was selected because it is standard on the distribution system of the Indianapolis Power & Light Company. It is within the limits of standard electrical equipment and the existing 440-volt synchronous motors could be rewound for 4.1 kv. conveniently and economically. Higher voltage would permit a material saving in copper cables, which could be more conveniently run in conduit or underground tunnels. Voltage regulation on the distribution circuits because of lower current value could be more easily controlled. Future load increases could be adequately handled at this voltage.

2. *Central Main Bus and Switching Equipment*—The main central bus is divided into two sections normally tied together by disconnect switches. The bus is a metal-inclosed structure. Each one of the three incoming lines and the seven distribution oil circuit breakers are 600 amp., 15 kv., 6 to 8 cycles interrupting time, with 150,000-kva. interruption capacity. Control for the main bus breakers is 125 volt d.c. battery used only for the breakers on this bus.

3. *Distribution Buses and Switching Equipment Designed and Located to Give Emergency Operation and Remote Control*—The five circuit buses serving the plant 4.1-kv. load are connected to the main bus through separate oil circuit breakers and reactors. Building 24 has three buses normally operating with the bus tie switches open, but the feeder circuits are of ample capacity to serve two buses over one feeder by closing the bus tie disconnect switches. Building 4 has two buses operating normally with bus tie disconnect switches open, but either of the two feeders will carry the load of both buses. Motor oil circuit breakers are of ample capacity both for load and interrupting capacity. Control and protective equipment for the motor and circuit is in the cubicle with the oil circuit breaker, where it is clean and easily accessible for inspection and maintenance.

4. *Power Factor Correction and Control*—By rewinding the old synchronous motors of 150 hp. and above for 4.1 kv. and all new motors of this rating and above to be synchronous motors of 4.1 kv., the plant power factor could be controlled. As the typical billing month indicates, the power factor is held to unity. Five old 600-hp. induction motors driving rubber mixing mills were scrapped in favor of 4.1-kv. synchronous motors principally for reasons of safety.

5. *Safety of System to Personnel and Equipment*—On the old system of the rubber mixing mill drive the distance of stock travel in stopping was 18 to 24 in., but by using the synchronous motors for dynamic braking and giving each operator complete control of the motor the stopping travel distance was reduced to 3 to 5 in. Since the plant has been in operation not a serious accident has taken place on these machines. An accompanying illustration shows one of the machines with the safety stop cable placed conveniently for the operator, in case he becomes caught in the machine or the machine develops trouble. Safety of the employees was considered also in designing the cable runs. All main distribution feeders are run underground to the distribution buses through tunnels or insulated ducts. All distribution runs are in conduit to the motors. All equipment is well grounded to a plant ground bus.

6. *Continuity of This Plant Operation With Other Plants of the Company*—Since the Indianapolis plant is one corporate part of the U. S. Rubber Company, and other plants depend on the continuous operation of this plant, it was considered important that the source and distribution of power be made as safe and dependable as possible. The installation of this new system involved a large sum of money, but it was considered to be a small per cent of the total investment and also the insurance it gave for continuity of high grade manufacturing processes was well worth the added expense of installing the best.

7. *Use of 440-Volt Equipment*—All motors under 150 hp. were kept to operate on 440 volts. These size motors are satisfactorily operating on 440 volts; in fact, they are more easily and economically handled on this voltage. The existing switching equipment was overhauled and put in good operating condition; although the interrupting capacity was too small, this was taken care of through proper relay protection, to be discussed later. A 600-kva., three-phase, 4,100/120-volt bank supplies plant lighting.

The 4.1-kv. synchronous motors range in size from 150 hp. to the largest of 1,075 hp. all across the line start.

Direct current at 250 volts is used for motor field excitation, motor oil circuit breaker control and for some small motors whose speeds need to be controlled within exact limits for production processes.

All the construction and setting of the equipment was carried out by the U. S. Rubber Company's engineers and labor. This fact in itself is valuable experience for the electrical maintenance crew of the plant. The rewinding of the synchronous motors was done by the manufacturers of the motors.

Relay Protection

All seven of the 4.1-kv. distribution feeders tapped from the main bus are protected by induction overcurrent relays. The three incoming main plant feeders are protected by "CR" directional overcurrent relays at the rubber company and by induction overcurrent relays at the Indi-

anapolis Power & Light Company's substation No. 6. The individual motor circuits have instantaneous overcurrent protection. These overcurrent relays are set to give proper co-ordination for faults from the motor to the utility source of power. In co-ordinating this relay protection a short-circuit current study was made for maximum and minimum capacities, using several different set-ups, and the data obtained, together with information on operating characteristics of the rubber plant's load, were used in arriving at the proper relay setting. In addition to the instantaneous overload relays the motors are protected by under-voltage relays, thermal overload relays and power-factor field removal relays. The power-factor field removal relay operates under some abnormal voltage, load condition, heavy surge or out-of-step condition to remove the field from the synchronous motor and allow the motor to come up to speed as an induction machine, then the field is automatically applied again.

Relay Setting

The test, calibration and setting of the main and distribution relays at the industrial substation were carried out by the utility company's relay engineers without cost to its customer. The individual motor protection was set by the manufacturers of the machines to correspond to the characteristics of the particular machines.

Owing to the fact that the plant contains such a large load of synchronous motors the operating characteristics are watched closely. Any unusual conditions of operation that arise will be given consideration by both companies for correcting the cause.

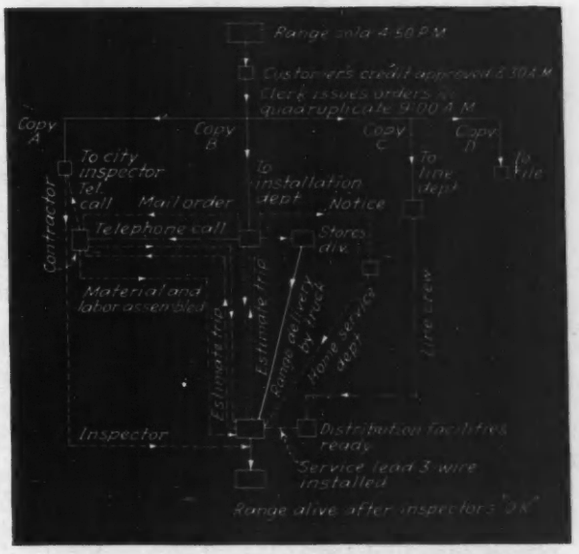
The operating record of the two companies since the new systems were installed has been good. Faults occurring inside the plants have proved the value of co-ordination of protective equipment to both the electric utility and its customer. In addition, the knowledge, experience and personal contact obtained were well worth the extra cost. Better and more continuous service, improved personal and customer relations, greater efficiency and co-ordination have been obtained through close co-operation of the two companies in the design of this power system, thus proving that co-operation pays.

Range Installations on 24-Hour Basis

Brockton Edison systematizes its sales and installation procedure so 85 per cent of ranges are at work 24 hours after purchase

GEORGE C. KING, *Sales Manager*
Brockton Edison Company, Brockton, Mass.

BY WELL-PLANNED organization of procedure the Brockton Edison Company has reached a point in sales and installation routine where 85 per cent of the electric ranges going into its territory are ready for service in the customer's kitchen within 24 hours of purchase. To accomplish this, close co-operation is of course essential between the utility, the merchandiser of the range, the wiring contractor and the city inspection department. The company serves an area of approximately 325 square miles, has about 36,000 residential customers with an 18 per cent electric range saturation and lists about 1,325 water heaters on its lines.



Simultaneous dispatching of order to buy electric range to installation department, line department and city inspector enables Brockton Edison to offer range connected and ready to use within 24 hours of sale

The territory includes the city of Brockton and a number of adjacent towns lying in general within a maximum radius of 20 miles of the urban center. The district representative system has been used for many years, this being one of the pioneer companies under Stone & Webster management to adopt this method of maintaining friendly personal contact with all customers.

The accompanying diagram shows the general scheme of procedure in handling range installation orders. A typical case is one in which the householder signs the order for a range, let us say, at 4:50 p.m. on a Wednesday, in the presence of the district representative ("D.R." for short). By 8:30 Thursday morning the D.R. turns in the order at the headquarters office in Brockton, which checks the customer's credit standing. If this is approved, the clerk issues a wiring order in quadruplicate by 9 o'clock. Copy "A" goes into a box at the main office reserved for the city inspector of wires, who calls at least twice daily for notification of prospective jobs. Copy "B" is delivered by office boy to the installation department at the company's general service buildings about one-fourth of a mile away, and copy "C" goes by the same carrier to the line department at the same place. It is now not later than 9:30. Copy "D" goes to the file.

The installation department telephones the contractor (by alphabetical selection from an approved list, or the contractor-dealer making the sale if not merchandised by the com-

[*Continued on page 39*]

Engineering Enterprise Needed by Electric Utilities

Engineering executive sees system limitations, reliability vs. insurance, economy in design, effective utilization of present facilities as enticing challenges to ambitious young engineers

EDMUND C. STONE,* *Vice-President and General Manager Duquesne Light Company, Pittsburgh, Pa.*

CLEARLY our first major engineering problem today is to make the most out of the system that we already have. In general, this will be accomplished by thorough engineering knowledge, on the one hand, of the operating conditions to be met and, on the other hand, of the characteristics, such as thermal capacity, insulation strength and operating efficiencies of the lines and apparatus now installed or available for future use. More specifically, I suggest the following subjects as embracing some of the more fundamental problems with which the power system engineer is concerned today.

Few pieces of apparatus in actual service carry constant loads for any extended period. The heating developed in each type of apparatus will of course vary with its load characteristics and the same load will have different effects on the different kinds of apparatus. Furthermore, most types of apparatus can carry much heavier loads for short periods than could be carried continuously. And since in most cases the maximum load to which each piece of apparatus is subjected comes only under emergency conditions, it generally happens that for these limited emergency conditions the capacity rating may be substantially in excess of the nameplate rating. Economy of design and operation demand that the ultimate load on each part of the system be as great as practicable.

The extent to which reserve capacity should be provided in the various parts of a power system will depend upon the probabilities of failure of the respective parts of the system.

While there may be possibilities in a system for very serious interruptions to service, the probabilities of such interruption may be very remote —so remote, in fact, that we are not economically justified in insuring against them. On the other hand, the possibility of other types of interruption, while not individually so serious, may be so imminent as to make large expenditures justifiable in order to reduce or eliminate them.

Reliability vs. Insurance

Obviously prevention is better than cure, and where practicable and economically possible it is better to eliminate the cause of failures than to provide insurance in the form of emergency equipment. Our present knowledge of the behavior of the power system under abnormal conditions and the more dependable equipment now available make it practicable in many instances to provide such a high degree of reliability in certain parts of the system that insurance against failure is not necessary. In other cases, insurance through spare parts is more practicable.

Even at the present time, with all of the technical advances which have been made in the past ten years, a substantial portion of the cost of the power system lies in the spare capacity and protective equipment which must be provided to protect service against interruption.

Of no less importance than the subjects referred to above is the problem of economy in design. It is in the very nature of things that we start with complex solutions of our problems and then work toward simplicity as we attain greater knowledge. Simplicity and reliability are the keynotes of economical design. Chairman Butler of the P.E.A. engineering section crystallized this problem when he said that "The engineering approach to our common problem is to apply the better materials as they are developed and to correlate and make use of additional operating experience to improve or more fully to utilize the equipment in various parts of the system, so that the various parts will either carry more load, be more efficient, be more economically arranged, be more reliable (thus requiring fewer spares), be smaller (thus requiring less space), be more self-contained (thus requiring less housing)—all of which tend to reduce costs."

Utilization

Our engineers must also understand the utilization problems of our customers. New uses for electric utility service are constantly involving new problems. In our territory service to electric welding and steel rolling mill loads, for example, involves heavy fluctuations of current, which in turn create special engineering problems. Developments in governmental regulation create metering problems which demand engineering solution.

In Pittsburgh we have had recent examples in all of these types of problem:

In their system capacity study our engineers have found several weak spots, in one of which particularly the full load output of the power plants is seriously limited by a step-up bank of transformers with insufficient capacity. Thus the system output can be materially increased by the expenditure of an insignificant amount of money in additional transformer capacity.

*Excerpted from address at recent meeting of Pennsylvania Electric Association, Bedford, Pa.

Again, our engineers have found that by increasing the electrical factors of safety in certain parts of our transmission system they can provide the same effective capacity that would be obtained from additional lines which would cost many times the amount of money required for the higher factors of safety.

In connection with utilization problems, we have felt an urgent need for measuring the demands of our small consumers. To meet this situation, our engineers have developed a new type of demand attachment for watt-hour meters which costs much less than other types on the market.

Danger of Complacency

Perhaps the greatest danger confronting our industry at the present time is the possibility of too much self-complacency. We have come to feel not only that, except under special limited conditions, we can offer the most economical and most reliable power supply that can be obtained, but also that we are doing everything practicable to provide a perfect service to our customers.

We should not forget, however, that we are living in a rapidly moving world, where the habits of the people are constantly changing and where new technical developments are made available almost every day. New applications for the use of electric power and new requirements in kind of service to be rendered are constantly appearing. While we can see no actively competitive source of general power supply at the moment, we cannot forecast when such a competitor may appear to threaten our business. Such a development would parallel those in other fields.

If we are to maintain our supremacy in the field of power supply we must stand ever ready to furnish adequate and reliable power service at the right price. In order to do this in the face of ever-changing conditions, our operating and engineering organizations should see to it that the greatest possible value is got out of every dollar spent and that methods and equipment are always the most effective that can be obtained. We cannot permit our organizations or our methods to become so crystallized as to lose that flexibility which is absolutely necessary to meet changing conditions readily. We should ever be on the alert for indications of new customer requirements, new technical developments and other changes which may affect our operations adversely if they are not given proper consideration, and we should keep fully informed with respect to new engineering developments.

Under these conditions we shall depend upon our engineers to provide the equipment and methods which will enable us to move forward to continued success. Perhaps more than ever before we are today in need of the very best engineering talent. Our engineers should blaze the trail of development and crystallize in advance the problems that will arise. They should sense the trend in the use characteristics of the service and lead the way in determining the future requirements in both power system and utilization apparatus. They should keep thoroughly informed on engineering development. They should co-operate with the manufacturers in seeing to it that the necessary types of apparatus to meet the expected requirements are available when and as needed.

Range Installations On 24-Hour Basis

[*Continued from page 37*]

pany), and by 10 o'clock the contractor or his employee meet a representative of the installation department by appointment at the residence where the range is to be installed. These two men immediately make up a piece-by-piece estimate of the wiring material and labor installation cost, based on a standard schedule of unit prices agreed upon by the company and the listed contractors. Long experience makes a short job of this, and by 10:15, or soon after, the contractor starts back for his office, assembles the wiring material and returns to the job. One copy of the estimate is kept by the contractor and the other by the company. Very likely he will be at work on the premises by 11 o'clock if the range is going into a Brockton home.

The line department foreman meanwhile has been checking up the distribution circuit facilities of the locality from maps kept up to date at the general service buildings, noting the service capacities.

The city inspector visits the job during the forenoon, having received word by telephone from the contractor that the wiring job will be done, let us say, by 2:30 p.m. If everything is satisfactory on the job in the forenoon the inspector issues a permit to the company either by telephone or by conditional written authorization to carry out its part of the work, but the service cannot be made alive until final inspection and approval on the part of the city. This is given after the installation is completed and found "O.K." by the inspector.

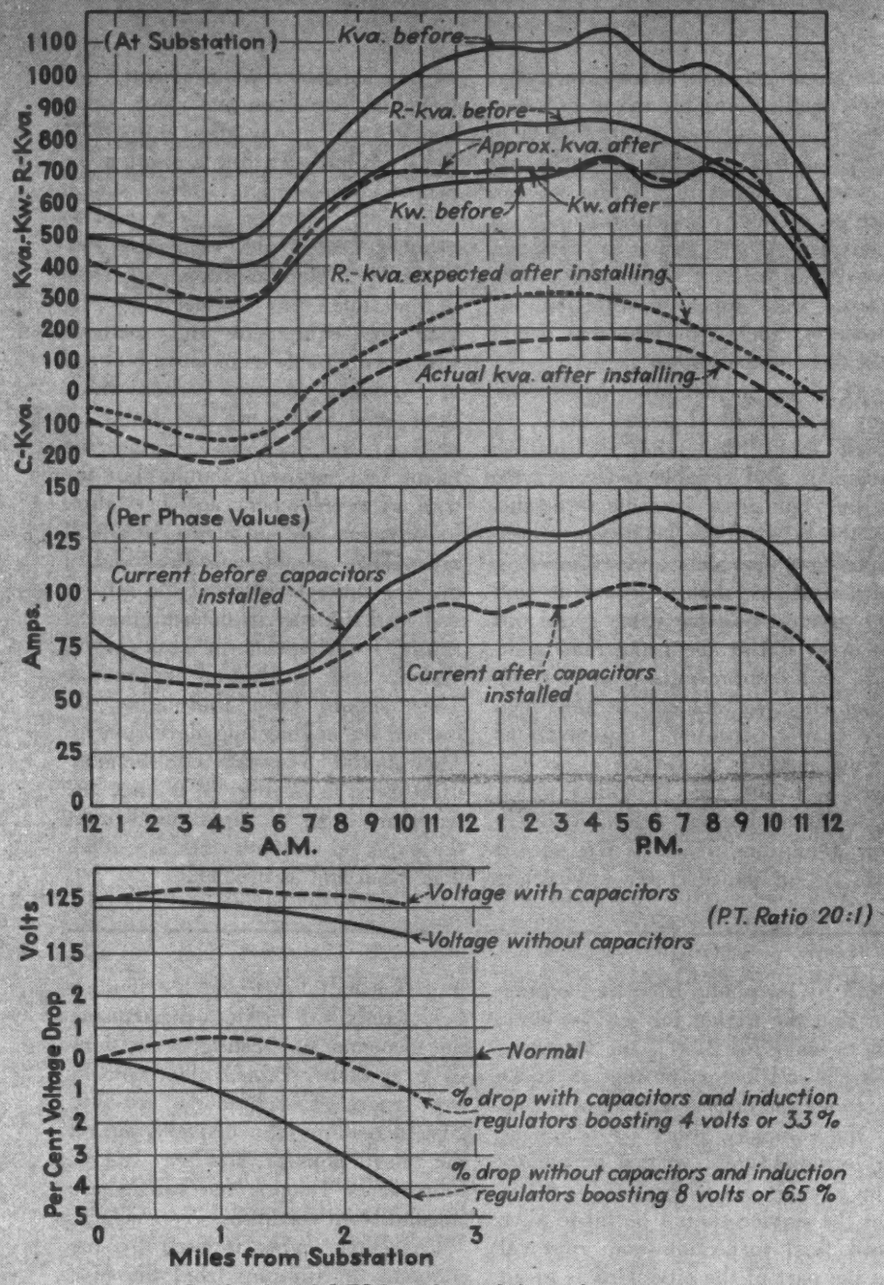
Working Smoothly

During the forenoon the installation department confirms the contractor's price and issues the necessary order to him by mail. The department checks up the readiness of the range for delivery and installation by reference to its stockroom and notifies the home service department that the range will be installed during the afternoon. A copy of each installation order goes to the home service department, which follows up the installation, and not later than the next day checks up the satisfactory performance of the range with the owner. The company maintains an uncrated, assembled (including pigtail installation) and tested number of ranges in its stock department, the elements and testing being done by a specially trained man. One or two ranges of each model are thus kept in readiness for delivery, but on the most popular size (a 10-kw., four-burner range), ten ranges are constantly in readiness.

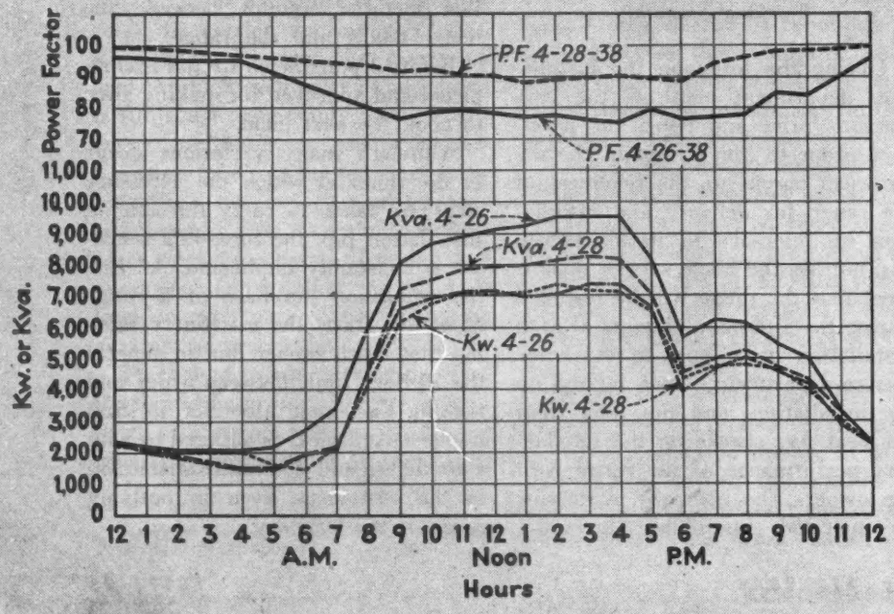
Concentric cable is used by the company in running from the pole to the service cap; rigid conduit from the cap to the meter switch, with full sequence wiring and flexible metallic conduit between the meter board and the range.

Before 4 p.m. the entire job is completed and approved for making alive to cook the next meal.

Although many variations occur in the times at which the necessary steps are taken to carry through an installation job, the foregoing schedule is constantly duplicated. An earlier afternoon purchase of a range of course starts the machinery moving that much sooner, but in general the 24-hour limit between order and making the range alive for its first home-cooked meal is adhered to with smoothness and no small satisfaction to the customers, even in outlying areas of the territory.



Load reduced 0.72 kva. for each kva. of capacitors—Current reduced from 140 to 105 amp. Substantially better voltage than with 6.5 per cent regulator boost



Peak kva. reduced by 1,000, while power factor goes from 78 to 90 per cent

POSSIBLY the use of capacitors has been delayed on some systems because of doubts about their freedom from subsequent troubles of a technical nature. Experience with 93,175 kva. of capacitors installed on seventeen systems to gain system loadability and improve voltage performance shows that these fears are largely unfounded. That this is so is substantiated by the following conclusions drawn from analysis of the operating results on those systems:

1. There need be little worry about reliable performance of capacitor units.
2. Such inductive co-ordination problems as arise can usually be solved readily by careful analysis.
3. Detrimental harmonic currents and resonant conditions are exceptional and not to be expected as common occurrences.
4. Calculations for desired results are readily made.
5. The calculated benefits are generally attained.

Failures Less Than 1 per Cent

The 93,175 kva. embraced by the study represent approximately 6,000 units. Of these 60,000 kva. were installed during 1937 and 26,000 during 1938. At the time of the survey, early in 1939, most of the units had served through two lightning seasons. Out of this total there were failures of 38 units, under 1 per cent.

Of the 38 failures, the causes were attributed as follows:

Eight to lightning.

Thirteen to manufacturing defects, and none of these occurred in the year 1938.

Seventeen to undetermined causes, some of which were probably due to manufacturing defects.

None to harmonic currents or resonant conditions.

Of the eight failures attributed to lightning, seven were 2,300-volt outdoor unit-type capacitors connected between phase and grounded neutral on wye systems. Two of these in a bank of 90 kva. failed under a direct stroke of lightning. In none of these cases was lightning protection provided. The other one of the eight failures attributed to lightning was in a bank of 180 kva., wye connected, with lightning arresters installed.

A substantial number of wye-connected capacitor banks are installed

Seventeen Systems Report Smooth Capacitor Performance

Operating experience with 93,175 kva. of corrective capacitors reflects low failure rate, little stubborn inductive interference and infrequent troubles from harmonic and resonant conditions

M. C. MILLER, *Electrical Engineer Ebasco Services, Inc., New York*

without lightning protective devices. Additional performance data will be necessary to determine whether or not it will be economical to install lightning protection for capacitors where one terminal is solidly grounded.

No failures of units due to high operating voltage were reported. Generally, units rated 2,300 volts are used on systems having a nominal voltage of 2,400, where the voltage on some capacitors is 2,500 to 2,600.

Two units failed on an underground ac. network system. These were installed in transformer vaults. The peak voltage was around 2,650 and the ambient temperature rather high. However, another failed in a vault where the temperature was not high. As these units were not fused, the high fault current destroyed the units and cause of failures could not be determined. In one of these cases the unit exploded and damaged an adjacent unit. The use of fuses to limit the fault current is being considered on this network system, on which 1,980 kva. of capacitors are installed and installation of an additional 1,980 kva. is being considered.

Resonance Blows Fuses Occasionally

One company with more than 6,000 kva. of capacitors installed experienced excessive fuse blowing with fuses rated approximately 160 per cent of nominal capacitor current. Fusing has been increased to 200 per cent. Resonance and harmonic currents were found. In one case it was necessary to move a 2,300-volt, 180-kva. bank to a location further out from the substation to avoid excessive capacitor currents. Tests with a cathode-ray oscillograph on two installations showed excessive 5th-harmonic currents between phase wires. In one case the 5th-harmonic current amounted to 61 per cent of the fundamental. These capacitor banks were installed in delta on 4,000-volt lines to avoid aggravating the 3d-harmonic currents.

It should be noted that with 5th-harmonic currents equal to 61 per cent of the fundamental no capacitor failures were reported. The extent to which these capacitors will stand overloading is indicated by the fact that fuses rated at 160 per cent of the normal current were blown without failure of the capacitor units.

One company reported some trouble with fuses being blown on capacitors installed adjacent to an induction furnace with power factor varying from unity to 50 per cent lagging.

No operating troubles due to harmonics or resonance were reported by the fifteen other companies.

Co-ordination Not Difficult

A few installations of capacitors on these seventeen systems have encountered telephone inductive interference requiring co-ordination measures. In most cases little difficulty or expense was necessary to reduce interference to a satisfactory level.

In one city, where nearly 15,000 kva. of capacitors are installed, three cases were encountered. One was with a 135-kva., 2,300/4,000-volt, wye-connected bank on a 4,000-volt feeder paralleling for a considerable distance a telephone cable and open wire lead. Ten-amperes 3d-harmonic current was flowing in the neutral of the capacitor bank. In that case the bank was replaced with a 4,000-volt delta-connected bank. This eliminated the trouble. Two cases of interference arose with two wye-connected banks on 13,200-volt circuits. In both those cases 9th-harmonic current was flowing in the neutral. A choke coil with by-pass relay was installed in the neutral of each bank. This reduced the interference satisfactorily.

One company reported that some cases of noise were encountered where telephone circuits were of the type using ground ringing without neon isolating gaps, especially where using multi-grounded neutral or where a uni-grounded neutral was accidentally grounded, such as by a broken-down arrester. Most of those difficulties were in rural territory. The same company reported a few similar cases in urban territory, where grounding of the telephone cable sheath eliminated the noise difficulties. In some cases it was found that the installation of capacitors between the source and the parallel provided sufficient short-circuiting effect for the important noise-producing harmonics to make it possible to operate capacitors in or beyond the parallel, and that this short-circuit effect may also reduce the noise, irrespective of use of capacitors in or beyond a telephone circuit exposure.

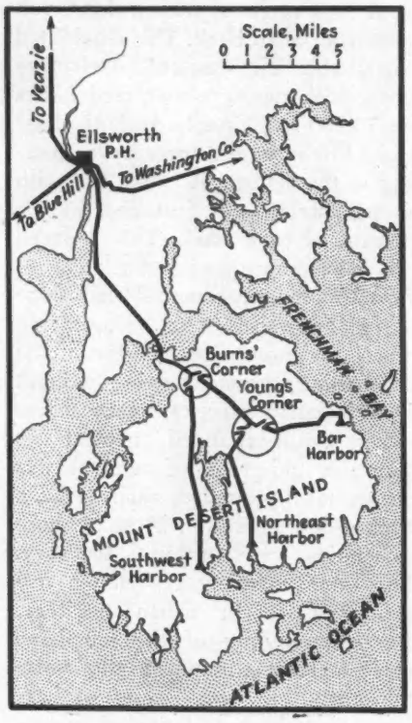
Three cases involving inductive co-ordination measures were reported by one company which has more than 19,000 kva. of capacitors installed on its system. However, that company, based on more than five years experience with operation of capacitors, considers that it is not necessary to formulate general meth-

[*Continued on page* 91]

Carrier Control Is Faster Than "Hunt Fault" Procedure

Line sections in isolated area restored in minutes vs. hours under former patrol system — Remote switching points at finger tips — Results superior to reclosing breakers and costs less

HAROLD W. COFFIN, *Electrical Engineer Bangor (Me.) Hydro-Electric Company*



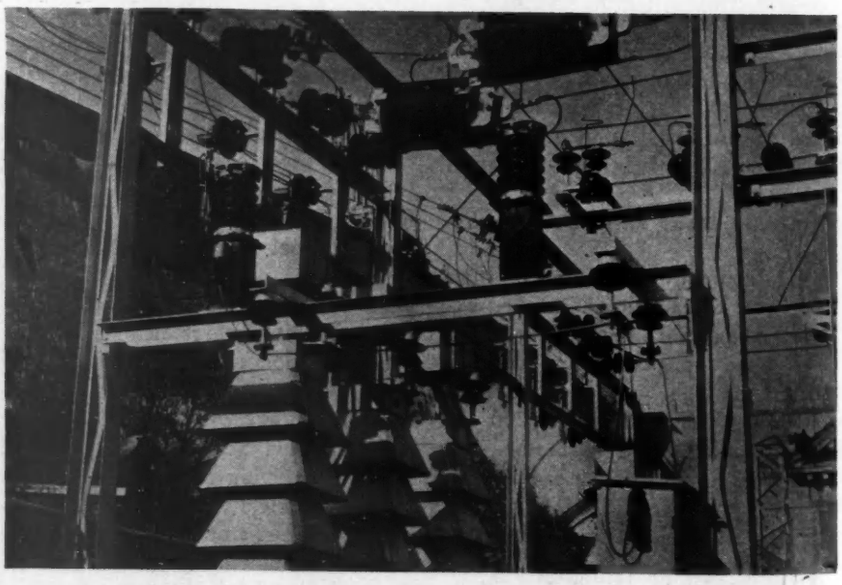
Schematic layout of line

TO SOLVE an acute operating problem involving restoration of transmission service in minimum time after interruptions on the 33-kv. line serving the Bar Harbor area, the Bangor Hydro-Electric Co. considered (a) the use of automatic reclosing circuit breakers and (b) the installation of carrier-current control of existing sectionalizing switches. About 35 miles of single-circuit pole line were involved, a main line and two branches, serving three substations at Bar Harbor, Northeast Harbor and Southwest Harbor. The load is seasonal and the summer residents of Mt. Desert Island demand extremely high-grade service, despite the fact that the island is 50 miles from system headquarters in Bangor and 20 miles from the nearest source of generation.

The line passes through so many miles of rough country that, under favorable conditions, a crew does well to locate and isolate the trouble within 1½ hours. In severe storms telephones outside the towns usually are affected more than the power circuits, and the delay in restoring electric service is correspondingly increased. Time and distance were major obstacles to service restoration. To sectionalize, test and reclose the section switches, the Bar Harbor crew had to drive at least 17 miles. Patrols through cuts during storms added further difficulties.

Investigation showed that automatic reclosing breakers on the 33-kv. main line and at branch take-off points would cost more than a carrier layout, present serious difficulties in the way of positive, selective relaying and give no indication to the system operator of the location of trouble. Carrier current, on the other hand, cost less, involved no automatic relay operation, gave the operator (at Ellsworth station) direct control of the four most frequently used section switches, provided a check-back signal to indicate the completion of each switching operation and cut the time required for sectionalizing, test and restoration of service to less than five minutes.

In the spring of 1938 the company installed a G.E."KCA-4" transmitter at Ellsworth, where by interphase coupling to the 33-kv. conductors a 52-kc. signal is sent out over the line. Carrier-frequency trap units at Ells-



Mounting of coupling capacitors and carrier frequency trap units on terminal structure

worth confine the carrier energy to the Bar Harbor line and help to insure maximum signal strength. Type "CW-3" coupling capacitors are used.

At the Burns Corner and Young's Corner switching stations type "KCA-200" patrol telephone stations modified for switch control were installed. On each of the four 33-kv. section switches was applied a 125-volt, direct-current motor-operating mechanism, type "MR-5." Each switching station was powered with a 130-volt Exide type "DMGP-3" storage battery with copper oxide rectifier for charging.

Since operation is required under a temperature range from 95 deg. F. to at least 25 deg. below zero, the battery houses were built of 1-in. "Cemesto" board, a Celotex insulating material, and provided with screened vents under the roof, these being open in summer and closed in winter. With a 2-kw. electric heater on thermostatic control, the battery temperature is kept up to at least 50 deg. F. in the coldest weather, thus maintaining full capacity for switch operation.

In the design of this equipment certain improvements over earlier designs were incorporated:

1. Elimination of separate 6-volt battery section and charger for operating tube filament circuits. By operating groups of tube filaments in series with a resistor across the 130-volt battery, the 6-volt battery is done away with and first cost, maintenance and chances for trouble are reduced.

2. Substitution of copper-oxide rectifier for tungar battery charger. Other companies consulted had had operating failures, due to loss of tungar tubes between regular inspection periods. The copper-oxide rectifier may age and the charging rate recede, but it is unlikely to fail completely and allow the battery to discharge between weekly inspections.

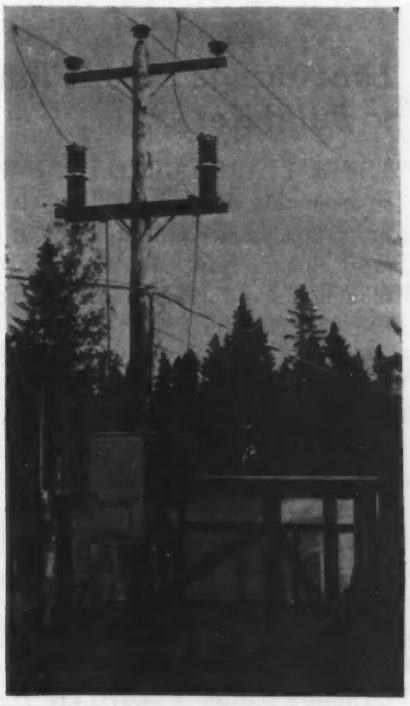
3. Improved design of battery house. Instead of laying the battery out flat, in a wooden cold-frame effect, with a large flat lid to accumulate quantities of snow and ice, the battery was installed on a three-tier rack, in a small well-insulated house having vertically hinged door sections.

Straight-line Operating Procedure

Now that carrier-current control is available, the operating procedure on the line is as follows:

If after three trials of the 33-kv. circuit breaker at Ellsworth the line still shows a short circuit, the Ellsworth operator, leaving the line dead, opens all switches having the carrier control, beginning with those most remote. He then closes the breaker at Ellsworth and charges the line to Burns Corner. Finding the first section good he leaves it alive and, using the carrier control, closes the section switches successively, one at a time. The switch closing the defective section will again trip out the Ellsworth breaker. The operator then opens the defective section by carrier, closes the breaker and closes section switches on all but the defective section. In this way trouble is located and isolated, service being restored to all but the faulty section inside of five minutes, an operation that formerly took at least 1¼ hours.

The first real test under emergency conditions came during the hurricane of September 21, 1938. With a tree across the line, at 7:56 p.m. the Ellsworth operator sectionalized the line, isolated the trouble and restored service to all but Northeast Harbor substation inside of four minutes. Service was back in full in 65 minutes. In another case a tree across the Southwest Harbor line brought out one of the limitations of the carrier. The Ellsworth operator could open and close at will the Young's Corner switches, but not those at Burns. It was found that the tree had put the 33-kv. conductors to which the carrier was coupled in actual physical contact. As soon as the short was cleared the carrier again operated normally. The line at this point was in triangular construction with the apex up, the carrier being coupled to the top conductor and one outside. After this outage the coupling was changed to the two outside conductors, to maintain maximum possible separation for the carrier phase.



Carrier current switching station at Young's Corner; battery house, receiver and coupling capacitors in foreground

Interior of battery house during construction period

In another case, Burns Corner lost a 33-kv. section switch from a direct hit by lightning. After replacing a blown 3-amp. fuse on the carrier set, 100 yards away, normal operation was resumed.

In sixteen months of service there have been nine occasions when the carrier has been called upon to operate switches. There have been 39 correct operations and nine failures. Even when switches failed to operate, the carrier telephone was working except in the Burns Corner lightning interruption. Of the nine fail-

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Editorials

S. B. WILLIAMS, *Editor*

Long-Range Sales Planning to Build Net

THREE YEARS ago ELECTRICAL WORLD was preaching co-ordination of load building with system planning in order that greater utilization might be had of the investment dollar. Now comes a new idea that takes this thought a step farther to provide for an improved net.

The Georgia Power Company has laid out a five-year sales program. This program envisions a 46 per cent increase in residential consumption, 43 per cent in commercial and 12 per cent in industrial. With these figures additional investment was calculated and then expenses and revenue set down.

The first year the balance to surplus after paying all expenses, interest and preferred dividends was estimated to increase 10 per cent and mounting rapidly at the end of four years to be 90 per cent. Here, in other words, is a long-range sales program based on definite objectives, and with that kind of a program forecasting no longer becomes a statistical uncertainty, but a positive basis for construction expenditures. And at the same time this program assures management of a healthy financial statement.

A good many people will say that times are too unsettled to make any long-range sales programs. In fields where consumption bears a direct relationship to general economic conditions, such a point of view may be justified. However, in a field where, except for the very worst of depressions, business can be made to expand with the proper promotion, it would seem that long-range sales planning might be of great advantage.

Of course, one of the reasons for the great improvement in surplus is undoubtedly due to the smaller growth in industrial than in residential or commercial consumption. The company may feel that industrial load will respond less rapidly to promotion than either of the others, or that, being more closely allied with general business, it will grow more slowly. It might be a good idea for other companies to get a similar long-range picture of what can be accomplished by promotion. The condition looked forward to in Georgia might not be singular.

However, even if the anticipated increases are not met by several per cent, the result will still be enough to encourage the company to look forward, and, also, it should be mighty encouraging to the employees.

Non-tamperable Fuse Interchangeability

NON-TAMPERABLE FUSES become mandatory again in 1941. They have been mandatory before, but it didn't stick because the manufacturers were not ready. Previous mandatory requirements required interchangeability of adapters or fuseholders.

In the last National Electrical Code, 1937 edition, non-tamperable fuses were merely made permissible, with interchangeability recommended. In the new code, to be out late this year, there is no mandatory provision regarding interchangeability.

The utilities opposed making non-tamperable fuses mandatory on the grounds that without requiring interchangeability there would be excessive confusion on the part of the customer and consequently excessive service calls. There is some question whether a code of safety can require such a provision as interchangeability. On the other hand, the electrical industry cannot force the people of this country to install non-tamperable fuses and then make it difficult for them to get the proper fuses. If the confusion and troubles become too great the public is simply going to say, "to —— with fuses."

A subcommittee of the electrical committee, N.F.P.A., has been appointed to take the matter up with the Division of Simplified Design of the Bureau of Standards to derive from those now available a design that will permit the use of an approved non-tamperable fuse in any adapter or fuseholder.

There is still a year from next November before the non-tamperable fuses become mandatory. In that time some agreement should be reached on interchangeability. It isn't as though there were a large number of designs, only two having been brought forward seriously.

Supplying Service to Law Breaker

MUST a public utility serve every one who applies for service and who obeys the company's regulations or is it charged with the responsibility of refusing service when it or its employees know that the customer is engaged in illegal activities? This point was decided by a federal court last week in Detroit when Consumers Power and two employees were convicted of knowingly furnishing gas for illegal distilling purposes.

Although the distilling took place a long time ago in Macomb County, before the Consumers Power purchased

the local gas property, the action was taken against the present owners. There apparently was no attempt made to deny knowledge of the activities of the customers for a larger than normal deposit was required.

The company contended that as a public utility it was obliged to serve all comers, while the federal government made this a test case to prove that a utility serving a violator of internal revenue laws may be prosecuted.

If this conviction stands it would seem unfairly to place broad police responsibilities on utilities, responsibilities whch government alone should shoulder. What, for instance, would be the position of a utility that serves a speakeasy, or a gambling casino, or a house of ill fame?

There are laws which hold an owner of real estate liable when he permits his premises to be used for illegal purposes, but if he refuses a lease the applicant may go to some one else. There is a great difference between a utility and an individual purveyor. A utility's refusal to serve places the company in the position of judge and jury.

On the other hand, this Michigan case may not be a precedent further than holding that the service must be a definite and not incidental part of the illegal operation in order to sustain a charge of conspiracy. That, however, is something for the lawyers to worry about.

The important point is that under this ruling utilities are charged with the responsibility of refusing service to customers whom they know to be engaged in illegal activities. We doubt whether this will ever be widely applied by government or local authorities, but it does establish another point toward which attack might be aimed by unfriendly interests.

Let the Senior Be the Supervisor

DESPITE all precautions that are taken in providing operating rules and hold-off technique accidents seem to happen. The reason seems to lie in the mental lapses of those who become habituated to doing hazardous things safely and then suddenly make a false move.

For this reason two men are usually assigned to perform the important operations, especially if they are some distance from centralized operating points. But, strangely, it appears that when two men are sent it is usually the junior who acts as the checker-up of the senior who is assigned to perform the actual operation.

This seems to be safety in reverse, because human nature is prone to result in the junior being hesitant to question the act of one who is presumed to know more about the significance of the intended operation and about the consequences of an erroneous move. This prompts the mention of some companies which delegate the junior to perform the actual operation with the senior employee as the supervisor. That procedure affords an excellent opportunity to capitalize on the educational potentiality of every dual operation. The senior employee is more likely to speak soon enough to prevent an error and he knows he is going to be accountable. Such inversion is also likely to improve the operating record and give assurance that competent men are being trained for early qualification to take major responsibility successfully.

An Unfair Comparison

THERE is a feeling in the minds of some people that government power agencies, and particularly REA, are much more active than private utilities in initiating new construction and operating ideas. Whether or not they were the first to have these ideas, or even experiment with them, is debatable. It is a fact, however, that REA has been aggressively searching for new lower cost methods and equipment and has lost no time in making experiments on a grand scale.

Because a comparatively young government agency can do things in this manner the utilities have been characterized as being unprogressive. To any one who understands utility operation and who knows how utilities work, such a characterization is unfair.

The utilities are busy in committees that meet regularly and frequently, in their own engineering departments and laboratories and in joint experiments with manufacturers to determine ways and means for improving service and product and at the same time reduce costs.

The difference is that the utilities' explorations must be more searching. They cannot make experiments on a grand scale with service to a large number of customers. Whatever they do must be right when they do it. Commissions, stockholders and customers insist on it.

REA, on the other hand, is beholden virtually to no one. Moreover, it does not have a long time to do its work. It cannot wait for results from laboratory-testing and field exploration that might perhaps take two years or more. It must "shoot the works," as the saying goes, and if it succeeds, fine and dandy. If it doesn't work, there is always the standard way to fall back on.

The utilities could do the same thing if it were not for the cost of failure, or for commission regulation. They have no unlimited treasury fed by taxpayers to dip into. They must account for every penny on a "useful" basis. There isn't a business man who does not at some time envy government agencies that can try this or that, with the knowledge that if it fails it can be written off to experience and something else tried.

There is no intention here to imply that REA experiments are so hastily conceived as to be crackpot. In fact, some of their ideas may prove beneficial to private utilities. The only point we are trying to make is that REA or any other agency using public funds can make experiments of a nature and on a scale that is denied to regulated private utilities. That the government bodies may appear to go faster does not necessarily imply greater progressiveness. We seem to still remember the old fable of the hare and the tortoise.

Crutches for Yardsticks

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

HOW THE public power boys do hate the idea of an honest yardstick! As a matter of fact, the term has almost passed out of New Deal usage, since Lilienthal's admissions before the special Congressional TVA committee. But they still try to use the idea without the word, putting up Representative Rankin every now and then to attack the rates charged by privately owned utilities in this or that section, saying how much the folks would save in electric charges in that locality if they just had the blessings of TVA power!

Two current developments bearing on the yardstick, however, are well worth noting. One occurred on the floor of the House of Representatives, and the other was actually a press release from Harold Ickes' Department of the Interior. The first concerned TVA. The second Bonneville.

Bearing in mind that an election will intervene before the next batch of annual appropriations, and that the best judgment obtainable is that the Republicans will gain seats in the House whether they win the Presidency or not, the votes on amendments to the 40-million-dollar TVA appropriation are interesting, to put it mildly.

TVA Amendment

The Administration could only muster a majority of six—110 to 104—against an amendment which would have cut the appropriation in half. And this when there are 97 more Democrats than Republicans in the House! Another amendment, aimed at the same appropriation, but directed specifically at the Coulter Shoals Dam, was defeated by only 112 to 109—a margin of three.

This may be a straw in the wind, but now comes a far more interesting nose count. For several years Representative Andrew J. May has been working up a hate against all hydro projects. He figures they literally take the bread out of the mouths of his coal miner constituents. Last year it was May's fight which forced a compromise on that hundred-million-dollar TVA bond issue. This time he was for all the crippling amendments again. He himself, after the votes just mentioned, proposed that no funds should be available to TVA unless that agency should be subjected to auditing by the General Accounting Office.

Now it happens that the General Accounting Office audits the books of every other federal spending agency, including those directed by Ickes, the old AAA, and its new soil conservation substitute. None of these New Deal agencies seems to have any objection to G.A.O. auditing.

But for reasons sufficient unto itself, and apparently satisfactory to every friend of TVA on Capitol Hill, the Tennessee Valley Authority is bitterly against the G.A.O. having any part in its auditing.

This feeling is so completely recognized in the House that the Administration leaders knew that if the May amendment should prevail it would be tantamount to defeating the TVA appropriation outright. Speaker William B. Bankhead took the floor and pointed out that there might not be time to get through legislation putting TVA under the accounting office in this session, whereupon the appropriation would be held up.

He did not say *why* there might not be time, but everybody in the hearing of his voice knew. They knew that every friend of TVA in both House and Senate would fight such legislation bitterly—that the TVA itself would rather go without the appropriation, badly as it wants it, than have the money at the price of submitting to the auditing of this agency which audits every other government-spending body.

Bankhead was able to rally the Democrats sufficiently on this to beat the May amendment 153 to 132. As a matter of fact, whips had been rushing through the House Office Building and Capitol rounding up Administration votes. The leaders had been badly scared by the earlier tallies and they were desperately anxious not to have the government's regular auditors put on TVA.

Why?

If you listen to the TVA friends, it is just a feud. Lilienthal fairly sputtered on the stand when asked about General Accounting Office auditors. Yet even the critics of TVA do not charge that there is any corruption which might be unearthed. But there certainly remains the suspicion that if TVA were compelled to keep its books in an orthodox manner, there might be some repercussions. Just maybe the taxpayers in the rest of the country would be annoyed. Just maybe there would be another hole in that yardstick!

Bonneville Subsidy

Another prize illustration of how the yardstick must be warped by loving public ownership hands concerns the notion of getting a steel plant out in the Northwest. After an extensive study, says a statement issued by the Department of the Interior, the "Bonneville Project" in paragraph 2 of this report says:

"Success of such a plant would be doubly assured, and the capacity could be increased, if the operation were tied into the National Defense program and could depend upon contracts for steel for merchant marine and naval ship construction in this area, or for the manufacture of army and naval ordnance, and munitions, for Pacific Coast defenses."

Can you imagine Honest Harold's wrath, and his Hugh Johnson rivaling expletives, if he were investigating some private interest and discovered a report approved by its responsible heads which contemplated subsidizing a loss leader for the purpose of crushing competition, and doing it under the cloak of "national defense"?

At least Ickes was honest about it. He gave it to the press. Probably he was thinking about "our fellows" when he read that second paragraph, rather than a lot of Tories!

NEWS OF THE WEEK

A.I.E.E. Winter Convention Draws Record Attendance

Electrical engineers from all sections of country gather for discussion of wide range of subjects — Three major prize awards made — President Farmer welcomes delegates

President F. M. Farmer (left) and Secretary H. H. Henline

Electrical engineers from all sections of the country gathered in New York this week for the winter convention of the American Institute of Electrical Engineers. The five-day meeting was devoted to electrical discussions and the progress in the arts.

President F. M. Farmer welcomed the visiting members and declared that there was a larger number of papers presented and covered a wider range of subjects. He pointed to the large number attending the meetings and felt that substantial progress was being made in the electrical industry.

At the general session on Tuesday Claude E. Shannon, Massachusetts Institute of Technology, was presented the Alfred Noble prize for the most meritorious technical paper presented under the award. Prof. J. K. Finch of Columbia University made the presentation. This is the fourth time that an A.I.E.E. member has received the Noble prize and the first time it has gone to a student. Seven awards have been made.

Gano Dunn, president of J. G. White Engineering Corp., in accepting the Hoover Medal, said that the engineering profession is a vast, untapped reservoir for public service.

Philip Torchio, former vice-president of Consolidated Edison Co. of New York, received the Edison Medal "for distinguished contributions to the art of central station engineering and for achievement in the production, distribution and utilization of electrical energy."

A record attendance gathered during the many interesting discussions, during which it was agreed that improvements in electrical machinery and apparatus have added greatly to national economy. Technical papers discussed advancements in power generation, transportation, electronics, communication, electric welding, power transmission, instruments, machinery and operations.

A new type of electrical amplifying apparatus for the control of power, known as the dynamo-electric amplifier, or "amplidyne" generator, was described by E. F. W. Alexanderson, M. A. Edwards and K. K. Bowman of the General Electric Co. and drew considerable interest.

A.I.E.E. MEETING—In the lobby between sessions were seen (l. to r.) Llewellyn Evans, TVA; R. E. Hellmund, Westinghouse; H. A. Langstaff, West Penn Power; C. B. Myhre, Westinghouse; A. P. Hayward, Duquesne Light; R. D. Evans, Westinghouse, and P. L. Alger, C. W. Fick and Dr. E. F. W. Alexanderson of General Electric

SEC Prepares Notices on Integration Hearings

Utility holding companies to get orders in near future — Commission irked at delay to meet requirements of "death sentence" section — Plan strict interpretation of law

The gigantic task of integration or "disintegration" of the electric utility industry will get under way in full force within the next week or ten days when the Securities and Exchange Commission issues its "Notice of Hearing" to all major holding companies, calling upon them to meet Section 11 provisions of the Utility Act of 1935.

Irked because major holding companies have taken no definite steps toward integration, the SEC is now ready to move without further delay.

No Favoritism

Work on these notices has been in progress for more than a week and it is expected that when a sufficient number have passed through the clerical mill the commission will begin serving them on the companies. The SEC has definitely decided that no one system will be singled out as the first, for it is pointed out that the first served may be the last to obtain sanction of its integration plan. It is likely that the order in which notices will be sent out will be "by blind selection out of a hat." The commission is being careful that there will be no charge of "favoritism."

As has been pointed out in earlier stories in ELECTRICAL WORLD, the SEC feels that all holding company systems should be brought into the integration picture at one time in order to eliminate any possible "bargaining" advantage. It is the belief of the SEC that when all companies are confronted with the same problem—sale, purchase, or exchange of operating properties to effect integration—the chance of circumstance advantage will be lessened. All systems will be placed on a more equitable basis.

The procedure adopted by the SEC in working out integration will be highly flexible. As companies reach agreements on sale and purchase of properties to fit into the integration scheme the SEC will give these precedent over other problems affecting the systems. There is no desire to complete an integration plan of one system before moving ahead with plans of other systems.

The notice from the SEC to the utilities will read: The SEC having examined the utility holding company system, and having found that the operating companies are not geographically integrated, hearings are ordered to determine what steps shall be taken to keep down the holding company system to one system of operating properties and any additional systems which comply with the A,B,C, requirements of Section 11-B of the utility act.

After the hearings, the companies will be given a "reasonable" time to present a definite plan of integration and the selection of its "primary" system and any additional systems which meet the A,B,C, requirements. Unless satisfactory voluntary plans are presented, the SEC will issue "show cause" orders why the holding company should not limit itself to one system and to divest itself of other properties which cannot be geographically and economically integrated.

There will be no stalemate in the integration proceedings, SEC declares. If companies are unable to agree on methods to comply with the act, the commission will take the initiative and order action.

Outline Methods

Many methods are open to the companies to dispose of investments (control) of operating properties. The companies can distribute the securities of the operating companies to its investors, can sell the stock of subsidiaries to the public, or to another holding company. SEC points out that there will be few, if any, instances in which there will any undue difficulty in finding a purchaser.

The present commission is definitely set on strict interpretation of the act, and while every assistance will be given in working out problems, the SEC will hew close to the line. A year or two ago there was a disposition on the part of the commission to give a more liberal interpretation to Section 11. Delay on the part of the utilities to work out integration and changes in commission personnel have altered the situation. The value of the holding company and its worth in the national economy is open to question more so now than before.

Heretofore utility executives have held the belief that if one or more operating companies in the system were serving adjoining area that they would be considered an economically integrated system and not open to question. The fact that this system serves such a wide area and exercises such vast economic influence will be considered grounds to question it in relation to the anti-trust laws. This poses a new problem in integration plans. Bigness may prove a disadvantage.

Court action to test the constitutionality of the act is not likely in the integration proceedings until final orders are issued by the SEC. After the final orders, the companies will have one year in which to complete integration. Politics will have no part in integration proceedings, SEC declares. Effort will be directed toward carrying out the wishes of the Congress and strict adherance to the letter of the act.

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SEC Unlikely to Be Associated Trustee

The SEC does not wish to become trustee in the Chandler Act bankruptcy proceedings of Associated Gas & Electric for a number of reasons. One is that SEC wishes to avoid any attack on it that the commission threw Associated into bankruptcy so that it could take over under the utility act. Another is that the law does not provide funds for SEC to operate as trustee, and there is some doubt that Associated could reimburse the commission for expenditures.

The integration of the utility system is so difficult and its corporate setup so complicated that SEC would rather have the court wrestle with the gigantic job.

As far as who will be appointed trustee, the SEC has no set notions. However, it is unlikely that any of the present management will be named. SEC prefers that some outsider, of high standing, be named by the court. John W. Hanes, former Under-Secretary of the Treasury; Charles True Adams, who is handling the Utilities Power & Light reorganization, now nearing completion, and Abe Fortas, counsel for the Bituminous Coal Commission and former counsel with the SEC, have been mentioned as possible trustees. They are acceptable to SEC.

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Associated Gas Hearings

Hearings to determine jurisdiction of the northern or southern district courts in the bankruptcy petition of Associated Gas & Electric's two top companies has been postponed until January 30.

Doble Conference Views Testing of Insulation

New equipment for generator, cable and oil check-ups interests operating engineers—Safety aspects of insulation testing emphasized — Manufacturers' sessions indicate progress

More than 25 states and 50 American power systems were represented last week at the seventh annual conference of the Doble Engineering Co., Medford Hillside, Mass., when more than 100 engineers devoted six days to the discussion of electrical insulation problems, supplemented by the display of new equipment for testing oil, generator windings and cables by the power-factor method.

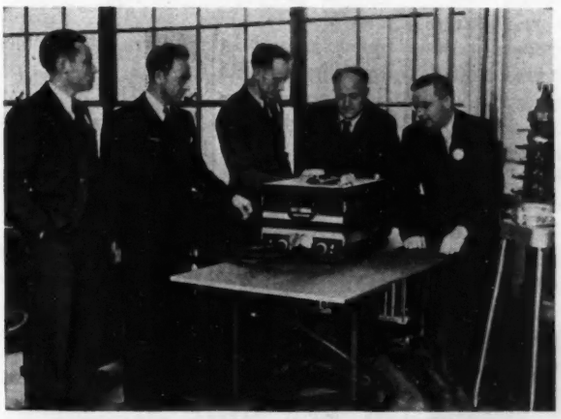
In his opening address President Frank C. Doble pointed out that the new apparatus displayed in 1940 extends the scope of testing to cover all insulation from the generator shaft to the customer's meter. Last year 12,741 client data sheets were studied (2,000 in 1934) and 434 reports sent out (nineteen in 1934).

Results of Testing

Gratifying progress in the testing of transformer insulation featured the proceedings this year. One company reported that as a result of more than six years' experience in testing some 4,000 transformers by the watts loss, power-factor method, an estimated saving of at least 100 failures in windings had been made. Placing the cost of a winding at $500, this represents a saving of approximately $5,000, excluding the benefits of discovering faulty bushings and of maintaining service continuity. The failure rate in transformers with tested power factors of insulation below 5 per cent is exceedingly low compared with the failure rate experienced in transformers having power factors above 5 per cent.

In the electrical machinery and equipment insurance session, the first of its kind held in these conferences, emphasis was laid by power system engineers upon the value of testing programs in safeguarding apparatus and service against breakdown and damage. It was forecast by them and by insurance company representatives present that premium reductions are logically bound to follow continued demonstrations of the effectiveness of such testing. Premiums are now based on the general experience of insurance companies with apparatus of specific classes and ratings.

Other papers discussed practice in circuit breaker testing, lightning arrester and pot-head testing, generator coil tests, cable studies and liquid insulation characteristics and applications. Notable advances were recorded in the application of "hot-collar" tests better to analyze the conditions prevailing in various portions of bushings.



DOBLE MEETING — General view of engineering session and a group examining new cable tester. L. to r.—E. W. Whitmer, American Gas & Electric; H. A. Cornelius, Public Service of Northern Illinois; C. F. von Herrmann, Alabama Power; O. E. Fawcett, West Penn Power; E. L. Schlottere, Philadelphia Electric

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Rejects Bonneville Contract for Power

The Eugene, Ore., Water Board, governing the 30-year-old municipal power system, voted last week to build a $510,000 steam plant of 7,500 kw. capacity. The action rejected a contract with Bonneville and ended a two-year controversy over the city becoming a customer of the government's power project.

The city estimates its steam standby plant will be cheaper than Bonneville power. The Bonneville-Eugene 150-mile transmission line thus shows little promise of earning back its cost soon.

Lane County, surrounding Eugene, voted two to one early in December against setting up a PUD designed to operate on Bonneville power.

Eugene, entirely without foundation, has been used by public ownership enthusiasts in Portland as exemplifying benefits of Bonneville power.

Plant completion is scheduled about June, 1941.

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Wins Advertising Award

Consolidated Edison Co. of New York has received a silver plaque from the Publishers Service Co. for the finest financial and public utility advertisement printed in a newspaper in 1939. The advertisement so honored is one of the "It's Only a Penny" series.

Utility Forecasting Needs Discussed at Meeting

Engineers and meteorologists gather in Washington to consider more pertinent and specific warnings of storms, floods, dark days and precipitation — P.E.A. sponsors sessions

Under the auspices of the Pennsylvania Electric Association committees headed by W. R. Hamilton and C. F. Merriam, more than 75 utility engineers met in Washington last Friday and Saturday with 25 meteorologists to discuss forecasting for the particular needs of power companies. A. G. Butler, PEA engineering chairman, said the large attendance fully warranted the effort to effectuate a better mutual understanding of the state of the art of forecasting weather and the desires of the utility industry for prompt, frequent information on which to arrange maintenance crews, have steam capacity ready for dark day loads, control hydro drawdown and meet flood and glaze conditions.

Will Extend Service

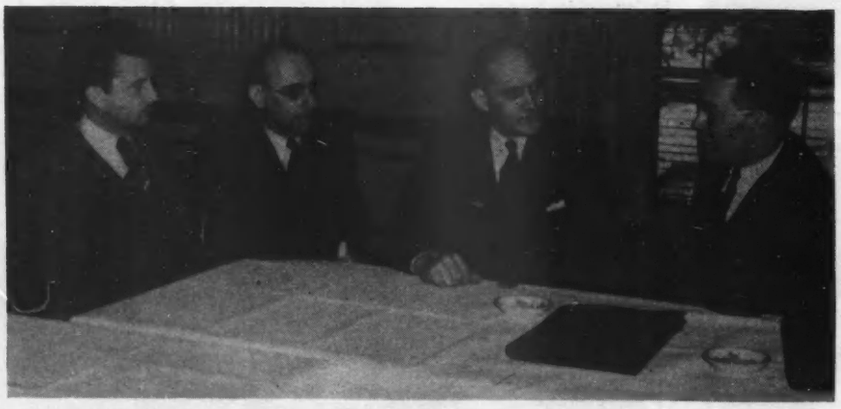
Chief F. W. Reichelderfer stated the Weather Bureau wanted to do everything possible within statutory and physical limitations to extend the prescribed public service to meet the needs of utilities. He stated there was a place for the private forecasters who disseminate by teletype or otherwise special interpretation of Weather Bureau data. Commander Reichelderfer expressed the hope that before long the new three-dimensional air-mass analysis would afford longer-range forecasts by the bureau.

C. W. Mayott (Hartford) and J. G. McKinley (West Penn) opened the sessions with an outline of utility use for weather information. H. W. Phillips (Pa.-N. J. interconnection) stated the need for advance knowledge of cloudy days because some companies experience a 10-15 per cent load increase. Mr. Mayott said it took 3,000 kw. and 33 minutes recently to clear glaze from a 66-kv. line. Eugene Bollay (attached to TVA at Knoxville) and A. K. Showalter by dialogue showed how prognostications were made for the January 4-12 precipitation in East Tennessee. Friday evening a large group saw the regional forecasts for Saturday and Sunday prepared at the Weather Bureau.

Saturday morning was devoted to discussion with the private forecasters. In opening the session Chairman Hamilton read a letter from Detroit Edison stating that results obtained in the first year with the Krick service warranted extension of the contract. Dr. I. P. Krick of Pasadena then told about the kinds of service he is rendering to such other utilities, Alabama Power, Appalachian, Central New York Power (see ELECTRICAL WORLD December 30, 1939). Representatives of these companies in general confirmed the validity of his prognostications.

Late in December Dr. Krick forecast the end of the autumn drought in the Coosa Valley, said Howard Duryea, and the information throughout the drought was valuable in connection with maintaining steam generation available for reliable service.

Dr. Krick read samples of bulletins he had sent to clients at frequent intervals during a stormy day. These were received by two-way teletype and answers were given immediately to further questions by the client. His map source is a daily (for the ensuing five-seven days) and a monthly map of average regional trends. He explained that the service is an adjunct of the meteorology department at California Institute of Technology, where he is associate professor. He calls himself only a special-service specific interpreter of Weather Bureau releases, beginning (as said also Chief Reichelderfer) "where the Weather Bureau leaves off." The bulletins are frequently graded A for "positive" forecast (temperature within 3 degrees accuracy), B for "relatively certain" (temperature within 5 degrees) and C for "uncertain" (10 degrees tolerance).



WEATHER FORECASTING—Leaders in the discussions in Washington last week. L. to r. —Dr. Irving P. Krick, Merrill Benard, division of rivers and floods, Weather Bureau; Commander F. W. Reichelderfer, chief of the Weather Bureau, and W. R. Hamilton, West Penn Power, chairman of P.E.A. operation committee.

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House Defeats Plans to Block TVA Funds

By a 153 to 132 teller vote the House last week defeated a proposed amendment by Representative May, chairman of the military affairs committee, which would have been a crippling blow to the TVA. Mr. May sought to withhold the $40,000,000 appropriation for TVA until it asked Congress for specific authority to expend the money, and also to place the TVA directly under the audit of the General Accounting Office.

An amendment sought by Representative Dirksen of Illinois, which was defeated 112 to 109, in effect would have prevented the starting of the Coulter Shoals Dam by cutting $1,000,000 from TVA appropriation.

The House also declined to adopt an amendment by Representative Faddis of Pennsylvania to cut the appropriation by $20,000,000 and one by Representative Case of South Dakota to reduce the TVA fund by 10 per cent.

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Advocates Utility Districts to Sell Shasta Dam Power

Secretary Ickes has advised the state of California to create and finance public utility districts to purchase and sell electric power to be produced at Shasta Dam.

In a letter to Gov. Culbert L. Olson, Mr. Ickes pointed out that the government must give preference to public agencies in the sale of electric energy from the project.

M.V.E.A. MEETING—General view of the dinner of the Power Sales Conference of the Missouri Valley Electric Association. At right, (standing l. to r.) H. E. Roberts, Empire District Electric; G. J. Neighbors, Oklahoma Power & Water; Duane Landon, St. Joseph Railway, Light Heat & Power; J. T. Jones, Empire District Electric. Seated, (l. to r.) R. A. Graves, Kansas City Power & Light, and Howard McGriff, Empire District Electric

Missouri Valley Group Sees Better Business

Power Sales Conference in Kansas City told that physical production will show increase — Improved industrial load factors seen advantage to utilities

A slight decline in accepted industrial indexes, accompanied by an actual increase in physical volume of industrial production, was forecast for the early months of 1940 by T. M. Salisbury, Ebasco Services, before the Power Sales Conference of the Missouri Valley Electric Association in Kansas City last week. Industrial production, he said, can be expected to average 110 for 1940 on the Federal Reserve Board index (it was 105 for 1940).

Rising revenue in industry, overloading of antiquated equipment, business optimism and the improved cash position of industry today, Mr. Salisbury said, all contributed to make 1940 a year of promise for power salesmen. Improved industrial load factors, he declared afford an opportunity to improve utility system load factors, but he specifically warned power salesmen against becoming overenthusiastic and committing their companies to long-term investments to serve short-term loads in the coming year.

George A. Davis, president of the M.V.E.A., injected another note of optimism with the observation that a sounder feeling seemed to exist on the part of government agencies, particularly SEC and FPC, toward the utilities. He saw signs that political attacks against the industry were on the wane also. However, he warned that the utility industry is vulnerable in attempting to sell electric service under a rate structure that the public does not understand. The structure must be simplified, he stated, or it will be simplified by the government, whether the industry likes it or not.

Vice-President H. H. Kuhn, Kansas City Power & Light, suggested that though the current trend to decentralization in industry was moving manufacturers from the city to the town and bringing a host of new industrial customers to cultivate, the bulk of new industrial business must be built by building lighting and heating load among existing customers.

Major W. H. Stueve, Oklahoma Gas & Electric and chairman of the power sales committee of the M.V.E.A. presented a code of procedure for power salesmen to guide them in the work of industrial development, the work of attracting and holding new industries in their communities. H. H. Ferrin, also Oklahoma Gas & Electric, presented a comprehensive statistical analysis of the relation of total power costs to manufacturing costs that showed an increase from 18 to 53 per cent in the percentage of purchased service for manufacturing from 1914 to 1929.

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Must Keep Property Records

A series of new regulations requiring all major public utilities in Maryland to maintain continuing property records covering physical assets was recently announced by the state Public Service Commission. The regulations would require all electric, gas, water, telephone and telegraph companies to bring the records up to date not later than December 31, 1940. All utilities with property valued in excess of $200,000 will be affected.

The records must be available at the request of the commission, but the companies will not be required to file regular reports.

•

Will Discuss Standards Revision in Wisconsin

Wisconsin Public Service Commission has scheduled a general hearing for February 8 at Madison to give Wisconsin electric utilities an opportunity to discuss the proposed revision of standards of electric service. The commission has prepared a tentative set of rules governing standards of service and equipment, tests, forms of rate schedules and other matters, following conferences between its staff members and utility representatives.

North American Units to Spend $61,000,000

New construction and expansion programs now under way or planned by operating utilities in the North American Co. group total approximately $61,000,000, the largest in nine years. Cash expenditures in 1940 will almost double those of last year, Edward L. Shea, president, said. Of the total program, $38,500,000 is scheduled for 1940 and $22,000,000 for next year. New steam generating capacity of 265,000 kw. will be installed.

P.U.A.A. Denver Meet Airs Utility Problems

The place and opportunity of P.U.A.A. in devising solutions to the many and complex problems faced by the utility business was the keynote at the second annual western conference of the Public Utilities Advertising Association, held recently in Denver, Colo. The conference brought together both advertising and sales executives of utilities from twelve states.

"As we come into the New Year, Keith Hartzell, association president, said, "We can cheerfully cultivate some hopeful ground and contribute more and more to the task of dispelling such hostility and misconception as still exist in the minds and hearts of our public. To this contribution the members of our profession and our association can and should bring effective methods, materials and ideas."

Mr. Hartzell pointed out that the P.U.A.A. group, with the instruments at hand and the inclination to co-operate, makes the advertising dollar of the utility business an investment of such certain return and profit that it can be honestly and sincerely glorified in terms of equal praise with the moneys devoted to the employment of any and all other factors essential to the success of the business.

Sessions were devoted exclusively and intensively to "shop talk" that covered more completely than ever before a range of public relations and promotional activities concededly essential to the industry's success.

Official host to the conference was the Public Service Co. of Colorado, with P.U.A.A. director Frank R. Jamison acting as chairman of the local arrangements committee.

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Utility Appeals Ruling in Unique Test Case

A jury in federal court in Detroit returned a verdict last week convicting Consumers Power Co. and two of its representatives on a charge of conspiracy to violate internal revenue laws. The testimony in the trial was that the utility served gas to illegal distillers in Macomb County. The two representatives convicted were Ralph W. Clark, district manager in Mt. Clemens, and W. A. Bertke, district engineer.

Mr. Clark testified that while he was aware of at least one instance in which gas was delivered for illegal distilling purposes, he believed the company was obliged to serve whoever applied and abided by regulations.

This is said to be the first time this issue has been raised where federal authorities may prosecute a utility which furnishes service to a law violator. Opinion is that should the conviction stand every utility will have to "police" its customers before granting service.

The company has appealed the decision to the federal court in Cincinnati.

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Farmers Oppose REA Plans

Members of the Minnesota Farm Bureau Federation, meeting in St. Paul recently, adopted resolutions opposing the federal government in its rural electrification program. Following the lead of similar protests by 23 county farm bureaus, delegates adopted a resolution demanding that the federal government stop building generating plants and instead build transmission and service lines to farms throughout Minnesota which need electrification.

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Correction

On the cover of ELECTRICAL WORLD, January 20, the caption should read that James M. Huebner, new Pennsylvania Power & Light Co. vice-president, succeeds the late Ralph B. Hull, and not Ralph B. Hill.

MEETINGS

Iowa Public Utilities Association — Annual sales and distribution school, Hotel Fort Des Moines, Des Moines, Iowa, January 29-30. Herbert Henderson, secretary, Security Building, Cedar Rapids, Iowa.

Edison Electric Institute—Prime movers committee, Detroit, Mich., February 5-6; electrical equipment committee, Netherlands-Plaza Hotel, Cincinnati, Ohio, February 12-13. Annual sales conference, Edgewater Beach Hotel, Chicago, March 18-23.

National Electrical Manufacturers Association—Mid-winter Conference, Waldorf-Astoria Hotel, New York, N. Y., February 5-9. W. J. Donald, managing director, 155 East 44th St., New York.

American Institute of Mining and Metallurgical Engineers — Annual meeting, February 12-15, New York, N. Y. A. H. Parsons, secretary, 29 West 39th St., New York, N. Y.

Southeastern Electric Exchange—Engineering and operation section, Robert E. Lee Hotel, Jackson, Miss., February 22-23. J. W. Talley, executive secretary, 308 Haas-Howell Bldg., Atlanta, Ga.

Oklahoma Utilities Association—Annual convention, Biltmore Hotel, Oklahoma City, March 18-19. Kate A. Niblack, secretary, 625-626 Biltmore Hotel, Oklahoma City.

Midwest Power Conference—Palmer House, Chicago, Ill., April 9-10.

Missouri Association of Public Utilities—Annual convention, Elms Hotel, Excelsior Springs, Mo., April 17-19. Jesse Blythe, assistant secretary, Merchants Bank Bldg., 101 West High St., Jefferson City, Mo.

Electrochemical Society—Spring meeting, Galen Hall, Wernersville, Pa., April 24-27. Dr. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Retail Group Asks Trade-in Value List

A resolution asking that refrigerator manufacturers set up a stipulated trade-in allowance in a new schedule to be attached to their local list prices and listing standard prices and allowances by year and model for all manufacturers was unanimously adopted at a group session on major electrical appliances held during the 29th annual convention of the National Retail Dry Goods Association in New York City last week.

The resolution also urged that these prices become a part of all price structures under the fair trade laws. A second resolution called on the N.R.D.G.A. to take "vigorous action" on the matter of wholesale-retail selling, with particular respect to the so-called "discount houses."

Both resolutions were adopted after prolonged discussion of talks on the wholesale selling and trade-in problems by Ralph Chipurnoi, Gimbel Bros.; A. M. Sweeney, sales manager for the refrigeration division of General Electric Co., and Bernard M. Zients, Associated Merchandising Corp.

No action was taken by the N.R.D.G.A. on the resolutions as adopted by the session and one observer, in commenting on the suggestions, said that while several manufacturers and distributors are interested in the proposal for definite trade-in values, there is no immediate prospect of such a plan being put through, manufacturers fearing price cutting.

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James Burke Dies

James Burke, internationally known engineer and inventor, died at his home in Erie, Pa., January 21, after a two weeks illness, of pneumonia. He was 66 years of age. Mr. Burke was president of the Edison Pioneers at the time of his death. He founded the Burke Electric Co. in Erie in 1904 and retired from that organization in 1935 to devote his energies to engineering research.

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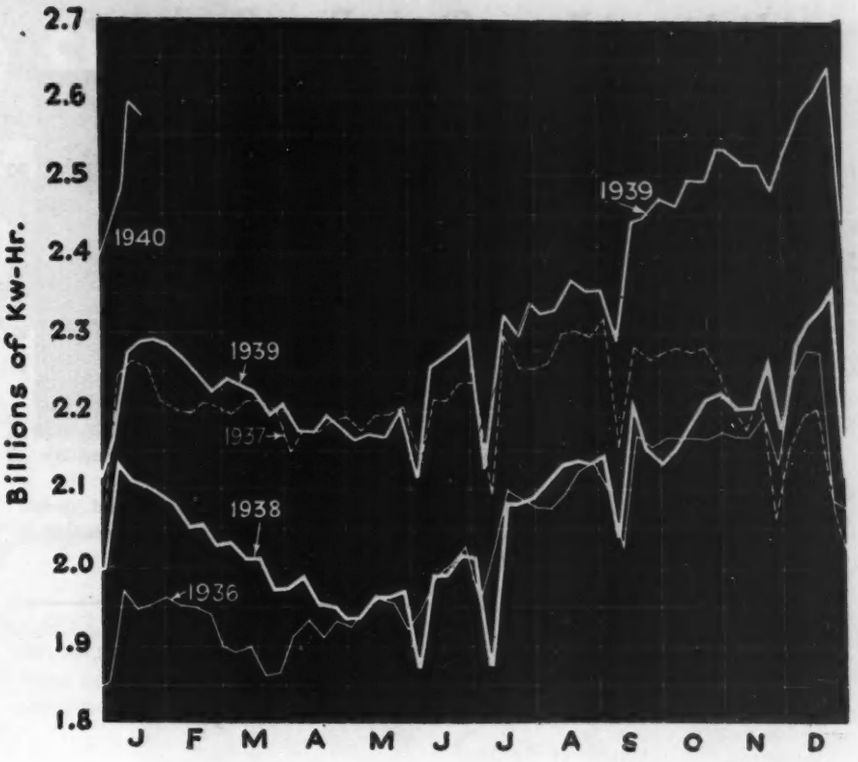
Campaign Adds Customers

Shawinigan Water & Power Co.'s wiring campaign, which took place from September 15 to October 31, was an outstanding success. It was announced that 865 new customers signed wiring contracts during the campaign period. All districts reached or exceeded their quotas.

Output Off Somewhat; 12.3% Above Year Ago

Paralleling the movement in the corresponding periods of 1937 and 1938, but contrary to 1939, the production of energy by the electric light and power industry during the week ended January 20 moved downward somewhat, compared with the preceding week, to 2,572,117,000 kw.-hr., according to the Edison Electric Institute. The gain over the output a year ago, which during the past few weeks had been gradually expanding until it exceeded 14 per cent, narrowed somewhat to 12.3 per cent. This still exceeds the December average, 11.9 per cent.

Despite the downward turn the week's output fell only 69,000,000 kw.-hr., approximately, short of the December peak, against 73,000,000 kw.-hr. a year ago and 93,000,000 kw.-hr. two years ago.



Weekly Output Millions Kw.-Hr.

1940		1939		1938	
Jan. 20	2,572	Jan. 21	2,290	Jan. 22	2,109
Jan. 13	2,593	Jan. 14	2,270	Jan. 15	2,115
Jan. 6	2,473	Jan. 7	2,169	Jan. 8	2,140
1939		1938		Jan. 1	1,998
Dec. 30	2,404	Dec. 31	2,121	1937	
Dec. 23	2,641	Dec. 24	2,363	Dec. 25	2,085
Dec. 16	2,605	Dec. 17	2,333	Dec. 18	2,202

Per Cent Change from Previous Year

	Week Ending		
	Jan. 20	Jan. 13	Jan. 6
New England	+10.2	+12.3	+ 9.5
Middle Atlantic	+10.1	+12.8	+11.8
Central Industrial	+16.2	+17.5	+18.1
West Central	+10.6	+12.8	+11.3
Southern States	+14.6	+15.8	+13.5
Rocky Mountain	+16.5	+15.4	+12.2
Pacific	+ 7.8	+10.6	+10.3
United States	+12.3	+14.2	+14.0

In line with the national total all of the regional percentages over the previous year decreased somewhat except the Rocky Mountain, which, after registering a low point of 3.3 per cent a month ago, has expanded to 16.5 per cent, and in doing so has taken the lead, by a close margin, over the Central Industrial. Further, all regions except the Pacific are more than 10 per cent above the 1939 level.

SEC Grants Issues for New Power Plant

The SEC has granted the application of Virginia Public Service Generating Co., recently formed, part of Associated Gas & Electric System, to issue $1,400,000 of 4 per cent bonds, $300,000 of 4 per cent serial bank notes and 3,300 shares of $100 par value common stock, proceeds to be used for the construction of a generating station.

The SEC raised the question of allowing the creation of a new company because of the integration and simplification provisions of the utility act. However, it found that "our national well-being" and the interest of the customers of Virginia Public Service outweighed these doubts.

The company proposed to construct a 15,000-kw. steam generating station at Alexandria, Va.

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Amend Export Permit

A license held by the Ontario Hydro-Electric Power Commission to export 80,000 kw. of electrical power to the United States at Niagara Falls has been amended to permit a division of this volume so that 50,000 kw. may be exported at Niagara and 30,000 kw. at Cornwall. The change does not increase the volume of power Ontario may export, but permits the commission to alter the outlet.

•

Wins Rural Line Decision

Union Electric Co. of Illinois has been granted certificates by the Illinois Commerce Commission to construct and operate 47.5 miles of rural electric line in Madison County.

The Southwestern Electric Co-operative, Inc., intervened in the case and stated that the Union Electric's proposed lines would result in duplication of service along part of the route in Godfrey township. The commission found, however, that the Union Electric Co.'s rates are "materially lower" than those of the co-operative and that the co-operative can construct the remainder of its proposed network of rural lines without building in Godfrey township if it so desires.

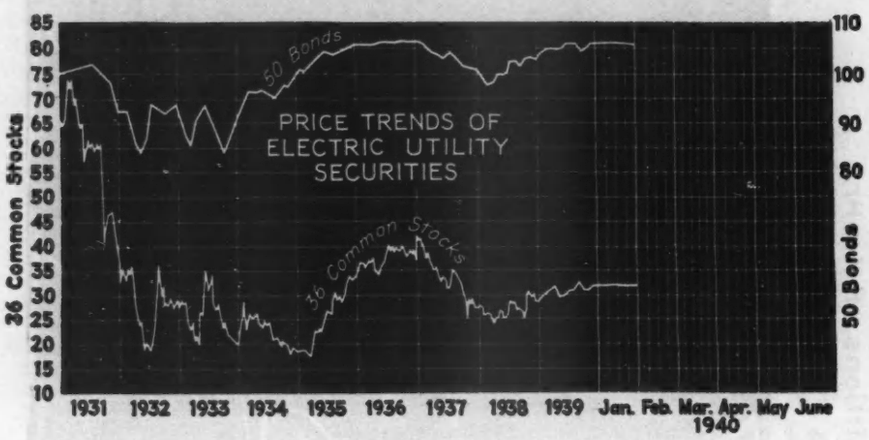
Utility Tax Bills Passed Over Veto

The New Jersey Assembly has passed four utilities franchise and gross receipts tax bills over Governor Moore's veto. The measures are designed to correct constitutional defects in similar laws adopted in 1938 which vest power of apportioning the taxes with the state tax commissioner.

All four bills passed by a vote of 37 to 18. Objections to the bills came mainly from Jersey City, Hoboken, Bayonne and Newark. These cities have got larger shares of utilities taxes in recent years by increasing valuation assessments on utility properties under an old law which provided for apportionment of the taxes on the basis of assessments by local officials.

In 1938 smaller municipalities banded together and obtained passage of the law placing the apportionment with the tax commissioner. The Court of Errors and Appeals held the Legislature had illegally delegated its power to the commissioner. The new legislation incorporates the apportionment method of Tax Commissioner Martin into law.

Light and Power Stocks Rise; Bonds Dip


50 Bonds
PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
36 Common Stocks
36 Common Stocks
50 Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1931 1932 1933 1934 1935 1936 1937 1938 1939 Jan. Feb. Mar. Apr. May June 1940

Utility stocks moved irregularly higher during the past week; "Electrical World" index, 32.1, last week 31.9; last year, 29.6. Some losses in the bond list were sufficient to carry "Electrical World" index to 106.0 from 106.1 the preceding week.

SEC Authorizes Sale United Light Units

Declaring that retention of the properties "appears repugnant to the integration provisions of the Holding Company Act," the SEC has authorized United Light & Power Co. to sell three gas companies in and around Chattanooga, Tenn.

The SEC noted that the income of the largest of these properties, Chattanooga Gas Co. has been declining and probably will continue to do so because of "the competition of the electric energy which has recently become available in this territory" from the TVA.

The three properties which United Light & Power and its affiliate, United Light & Railways Co. will sell are:

Chattanooga Gas Co. to be sold for $810,000 cash to Federal Water Service Corp., Fayetteville Natural Gas Co. and Cleveland Gas Co. to be sold to A. J. Goss, now associated with the management, for $3,000 and $17,000, respectively.

SEC said the properties being sold "are geographically remote" from other properties in the United Light System "and therefore probably should not be retained under the integration program."

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$10,962,000 Bond Issue by Pennsylvania Water

Public offering of $10,962,000 of Pennsylvania Water & Power Co. refunding mortgage and collateral trust bonds, 3¼ per cent series, due 1970, was made this week. Bonds were priced at 105 and accrued interest.

Net proceeds from the sale of the bonds will be applied to the redemption on or about March 1 of $10,962,000 of the company's first refunding mortgage bonds, series B, 4½ per cent, due 1968.

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Standard Gas Issues Hit on SEC Ruling

Possibilities that the SEC would close the source of income of Standard Gas & Electric from the Philadelphia Company, as reflected in its decision last week in adjourning indefinitely the hearings on the proposed capital restatement plan of Philadelphia Company, caused heavy selling of Standard securities and the driving of prices to new low levels.

As almost complete disorganization in the market followed the announcement of the decision, SEC began an investigation as to the source of the heavy selling. Some recovery was noted this week in the market for Standard securities.

The Philadelphia Company recapitalization plan proposes a write-down in the value of the Pittsburgh Railways assets and a reduction in the stated value of the company's common stock. The surplus created, together with capital and earned surplus, would be used to write down the investment in the railway properties.

It is likely that the SEC will consider the proposal of Philadelphia Company in relation to integration of the Standard system. Recently the SEC cut off the source of income of Associated Gas & Electric Co. from its underlying holding unit, thereby throwing the two into bankruptcy and a complete reorganization, with system integration to be considered.

SEC to Reopen Case of Consumers Power

Reargument of the Consumers Power Co. financing controversy has been set by the SEC for January 30 in Washington on petition of counsel for the company. This will reopen the petition by the Michigan utility to sell $10,000,000 of new bonds for construction purposes. On the original petition the SEC allowed $18,594,000 of bonds for refunding and a $3,500,000 contribution by Commonwealth & Southern to the equity of Consumers Power.

It is expected that the SEC will go into greater details on the question of the relation of the bankers to the utility and the question of affiliates. An important indication is that SEC will view the position of Consumers Power in the plan of integration of Commonwealth & Southern. Belief is held in SEC quarters that Consumers Power is large enough to be self-sufficient as an independent operating company without holding company assistance. Another is that Consumers Power can sell its common stock to the public as readily as its bonds.

While the SEC was divided in the Consumers decision, opinion is that it is unlikely that the commission will reverse itself following reargruments. However, the SEC realizes that in the future it must allow operating companies in less favorable corporate position to sell bonds to raise new capital. Thus, the consumer issue presents a serious problem.

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Seeks to Sell Securities

Trustee for Utilities Power & Light Corp. has asked SEC approval for a sale of certain securities of Central States Power & Light Corp. and Central States Utilities Corp. to Frank J. Lewis of Chicago, Ill., for $1,600,000 plus interest at 4 per cent from December 18 to date of the sale.

Utility Reports

	Net Income 1939	1938
*American Light & Traction and subs.	$4,917,184	$4,813,042
*Birmingham Electric	618,302	504,313
*California Oregon Power...	984,662	893,227
*Continental Gas & Electric and subs.	3,555,548	3,903,695
*Duquesne Light	10,271,623	8,826,265
*El Paso Electric	376,458	353,264
*Mississippi Power & Light..	500,752	659,600
†Public Service Corp. of N. J. and subs.	25,727,763	22,733,245
*Savannah Electric & Power..	399,842	364,206
*Southern Colorado Power...	263,099	223,037
*Western Public Service and subs.	171,819	205,625

*Twelve months ended November 30.
†Twelve months ended December 31.

NO INK TO SPILL

NO PEN TO CLOG

with this NEW *low-priced, light-weight recording instrument*

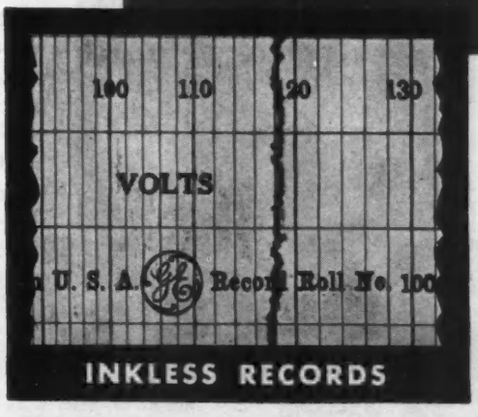
ON those jobs where ink recording has proved troublesome and messy, you'll find that General Electric's new inkless recorder, Type CF-1, gives an accurate, easy-to-read record.

USES NO INK

There's no pen to clog—no ink to "paint" the chart on highly fluctuating loads. And there's nothing to evaporate or spill. In temperatures as low as −10 F and as high as 120 F this new inkless recorder gives successful operation.

IT'S LIGHTWEIGHT

The Type CF-1 is small and compact and light. It weighs only 12 pounds—less than half the usual weight of recording instruments. It's easy to carry around.



← Photograph of actual voltage record made by inkless Type CF-1 recorder

INDOOR OR OUTDOOR USE

You'll like the flexibility of this new inkless recorder. You can use it indoors or outdoors, and you can mount it on a wall or on a pole. Wherever it is, it will give continuous operation for as long as 30 days without attention—a great advantage where frequent servicing is impractical.

IT'S LOW-PRICED

This is the latest word in recorders, and General Electric's newest contribution to measurement savings. It's inexpensive, too. Publication GEA-3187 contains complete information. Call your nearest G-E office for a copy, or write General Electric Company, Schenectady, New York.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

OPERATING PRACTICES

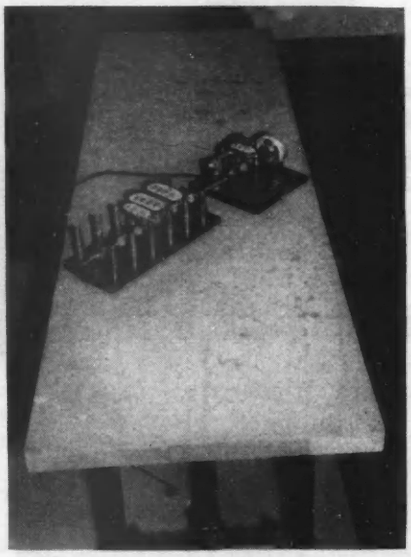
Check Seven Registers Instead of One

By J. W. CUDDOHY
Superintendent of Electric Meter Department
Consumers Power Company, Grand Rapids, Mich.

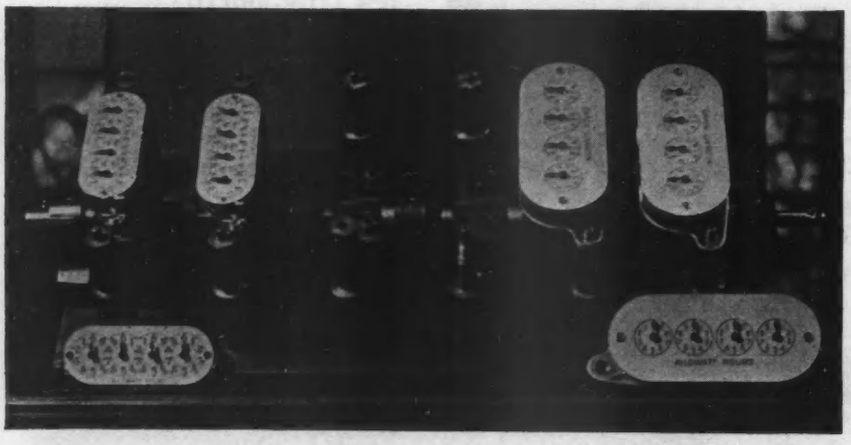
In conjunction with gang meter testing it is advantageous to gang check meter registers for ratio, and a standard General Electric Company one-position register checker has been extended by the meter department of the Grand Rapids Division of the Consumers Power Company to check seven registers simultaneously instead of only one.

The shaft of the standard checker was extended with a flexible coupling to six additional register positions. Necessary gears for meshing with the meter register under test were secured from the General Electric Company and mounted on a shaft turned by the standard checker motor. On a bedplate 6x14x$\frac{1}{2}$ in. are mounted hexagonal posts to support the register. These posts are made from $\frac{3}{8}$-in. hexagonal stock and are threaded on the inside so that a micrometer adjustment of meshing with the driving gear may be secured.

The main shaft is $\frac{5}{16}$-in. steel and the bearings are bronze on the present checker, but an additional checker under construction will utilize roller bearings. The cost to build is approximately $75.



Assembled register checker in operation.



Extension for standard register checker permits seven registers to be tested at one time; close-up view.

Test Identifies Arc Circuit Faults

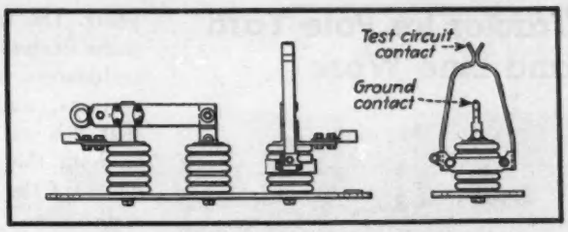
Existence and nature of faults on the series street lighting circuits of a Southern utility are determined by a fundamentally simple test that can be made by the plant or substation operator without leaving his station. With the test circuit used it is possible for the operator to determine whether a single series street light loop is grounded at one or more points, open at one or more points or whether the circuit is complete. However, the test will not determine where the fault is or determine how many grounds or open circuits exist in the loop.

Fundamentally, the test circuit, shown schematically in the accompanying diagram, is the familiar battery and test lamp idea modified to suit the needs of an extensive overhead series circuit only the two end terminals of which are accessible. As shown, each end terminal of the street light loop is brought to the center post of a single-pole, double-throw switch, modified by the addition of a third contact ("T" on diagram) with which the blade may mate.

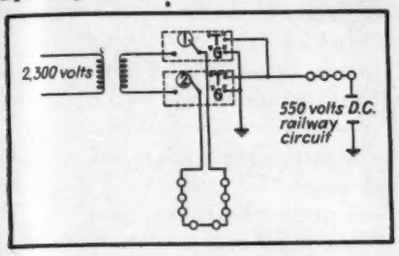
One of the two original contacts on each switch is connected to the secondary terminals of the street light transformer and it is through these contacts and the switch blade that the street light circuit is energized while in normal operation. One of the two remaining contacts ("G" on diagram) of each switch is connected to a common ground. The third contact ("T") on each switch is connected through a lamp bank and 550-volt d.c. supply source to ground.

Using this arrangement the street

Type of modified single-pole, double-throw switch used in locating series circuit faults



Test circuit detects and identifies faults on street light loop



light circuit is tested out in the following manner in time to clear faults before it is energized for the evening.

Checks are made with blades successively in the following positions:

1. Blade 2 open, blade 1 on test clip "T."
2. Blade 1 on ground clip, blade 2 on test clip "T."
3. Blade 2 on ground clip, blade 1 on test clip "T."
4. Blade 1 open, blade 2 on test clip "T."

(a) With a complete circuit and no grounds, lamp will light on tests (2) and (3).

(b) With a ground on a complete circuit, lights will light in all tests.

(c) With an open circuit and no grounds, lights will not light in any test.

(d) With an open circuit and a ground on one side of the open, lights will light when switch on the grounded leg is on its test clip, but not when switch of the underground leg is on the test clip.

(e) With an open circuit grounded on each side of the open, lights will light in all tests as in (b).

The test procedure outlined above has been used for some time on the system of this utility with complete success. It has the advantage that it arms trouble shooters with information as to the type of trouble to watch for and gives some indication of whether there may not be more than one source of trouble existing.

•

88-Ft. Pole for Rural Line

To carry a rural electric line across a navigable stream where it was necessary to clear the average river height of 72 ft. required by the War Department the 4-County Electric Power Association put an 88-ft. creosoted Southern pine pole into service near Columbus, Ohio.

The pole weighs approximately 4,650 lb. and was pressure-treated with 8 lb. of creosote per cubic foot, absorbing a total of 85 gal. of preservative. A 105-ft. span carries the line across the Tombigbee River, on the south side of which a slight bluff rises to a height of 37 ft. above the average high-water level of the river, while the north side is low, flat land, much of which is inundated during the rainy season. A short pole, 55 ft. long, was installed on the south side and the 88-ft., Class 3 pole on the north bank. Hard-drawn No. 4 copper wire was used.

•

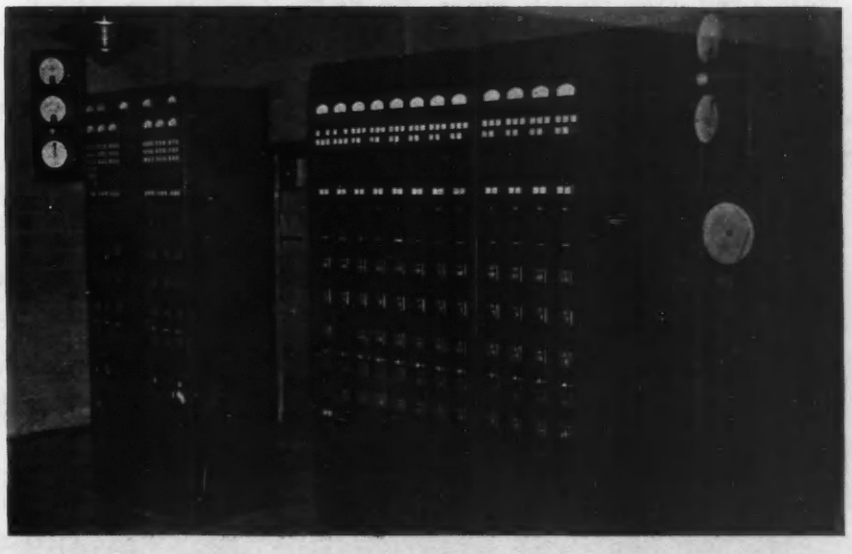
Relay Houses Save Switch House Space

By using miniature instruments and controls on the switch-house control board and installing relays and metering equipment at Aetna substation in compact steel "relay houses" in the substation yard engineers of the Northern Indiana Public Service Company achieved a triple objective. With this one move they were enabled to build a smaller, less costly switch house. They saved on cable costs by making it unnecessary to run anything but light control and telephone cable into the switch house, and by putting the metering equipment as close as possible to their associated current and potential transformers in the yard they kept down burden on the secondary of these transformers, improving accuracy.

Aetna substation is located just outside Gary, Ind., and is a transmission substation. Here the voltage of four 132-kv. incoming lines is stepped down to 33 kv. in a 40,000-kva. transformer bank for transmission over ten outgoing 33-kv. lines. There are two outgoing 132-kv. lines.

In planning the station it was felt that accurate metering of power flow was more essential than that the station operator be able to read values of circuit voltage and current on station-indicating instruments to within a few per cent. Consequently, instead of bringing heavy current leads a considerable distance to metering and indicating instruments in the control house, meters and also control relays were located in all steel houses in the station yard. Secondary current and potential transformers in these houses stepped current and voltage down to values that could be brought to the miniature indicating instruments on the switch-house board in inexpensive paper-insulated telephone cable. Station equipment was operated through miniature controls on the main switchboard over low cost control cable operating at 130 volts from the station battery.

Relay houses, which are of all-steel construction, insulated and heated in winter by thermostatically controlled forced convection unit heaters, cost



Put relays and meters in substation yard, use miniature controls on switch-house main panel. Results—compact, low-cost, switch house; cable economy, metering accuracy

between $70-$100 each. They are 8 ft. long, 10 ft. wide, inside, and have an inside height of 8 ft. It is conservatively estimated that to accommodate the metering and relay panels now housed in these cubicles ground area of the main control house would have to be at least 600 sq.ft. greater and correspondingly more costly. It is also noted that the $500-$700 for the seven relay houses represents only a portion of the additional expenditure that would have been necessary for cables had metering equipment and relays been located in the control house.

•

Determines Economic Transformer Size

By A. G. PERGANDE
Wisconsin Electric Power Company

For the purpose of investigating distribution transformer economy five secondary sections were selected and recording meters were installed at the transformers to supply a continuous record of fifteen-minute demands for a period of one week. From these and manufacturers' data we obtained the copper loss of the transformers. By applying proper correction factors to compensate for the decreased consumption during the summer months the total copper loss per year was obtained. Similar loss data were prepared for the next size smaller and larger units. Copper and core losses were evaluated at $0.005 per kilowatt-hour, and the fixed charges at 10 per cent of the installed cost. From the data curves were plotted to give a picture of the conditions from which an analysis may be made to determine the proper size transformer that should have been used in each of the five cases.

In order fully to understand the details of each of these five installations the following table has been prepared:

Data No.	Residences Served	Vacant Lots	Range Saturation
1	25	34%	36%
2	22	35%	32%
3	39	51%	18%
4	20	5%	30%
5	14	42%	43%

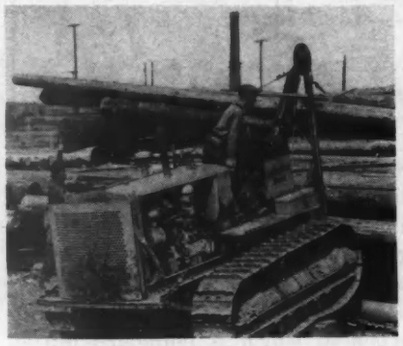
Data No.	Water Heater Saturation	Peak Demand, Kva.	Economic Size Transformer
1	20%	22	18.5
2	18%	19.5	17.5
3	18%	28.8	22.5
4	35%	29.5	24
5	29%	16.6	11.5

Data No. 4 involve a secondary section in a district fairly well built up, only 5 per cent of the lots being vacant. The four other cases involve city blocks in which 34 to 42 per cent of the lots are still vacant and present a possibility of appreciable load increase within the next few years. The ratio of both ranges and water heaters connected to customers' residences varies for the different sections, and it is to be expected that this variation will be reflected in both the maximum demand and shape of the load curve. The results indicate that we overestimated the rate of load growth for the sections covered by data No. 2 and data No. 5, but in both cases the loss per year is very small. As the load increases in the section illustrated by data No. 5, the total annual losses will change and cause this curve to drop to a more or less horizontal position.

Data were also used to show the relationship between peak demand and economic transformer size. These data gave peak demand divided by 1.35 as fixing the economic size of transformer. This factor will vary, depending upon the number of ranges, water heaters and other major appliances connected to the section, but the results obtained will insure a closer approximation than is otherwise possible and will result in transformer sizes that will assure the lowest annual cost.

*Abstract of paper Wisconsin Utilities Association.

Tractor for Pole Yard and Line Work



Montana Power loads, yards, decks and skids 35 to 75-ft. poles in its pole yard at Great Falls with this Caterpillar "D6" tractor, equipped with "Hyster" winch. Tractor also helps out in miscellaneous line work. In operation eight hours a day, the tractor uses 2½ gal. of 8-cent fuel an hour.

Evaluation of Distribution Transformer Copper Losses

Data	Transformer Size	Copper Loss Kw.-Hr. per Yr.	Copper Loss at $0.005 per Kw.-Hr.	Core Loss at $0.005 per Kw.-Hr.	Revenue Loss at $0.01 per Kw.-Hr.	Fixed Charges at 10%	Copper Core and Revenue Loss	Total Loss
No. 1	10 Kva.	1850	$ 9.25	$2.63	$17.16	$12.09	$29.04	$41.13
	15 Kva.	1262	6.31	3.49	10.79	16.02	20.59	36.61
	25 Kva.	725	3.61	5.24	5.35	20.48	14.21	34.69
No. 2	10 Kva.	1610	8.05	2.63	14.39	12.09	25.07	37.16
	15 Kva.	1136	5.68	3.49	9.20	16.02	18.37	34.39
	25 Kva.	656	3.28	5.24	5.00	20.48	13.52	34.00
No. 3	10 Kva.	2400	12.00	2.63	23.80	12.09	38.43	50.52
	15 Kva.	1705	8.53	3.49	15.19	16.02	27.21	43.23
	25 Kva.	924	4.62	5.24	8.10	20.48	17.96	38.44
No. 4	10 Kva.	2550	12.75	2.63	27.30	12.09	42.68	54.77
	15 Kva.	1798	8.99	3.49	17.30	16.02	29.78	45.80
	25 Kva.	1009	5.05	5.24	9.20	20.48	19.49	39.97
No. 5	10 Kva.	957	4.78	2.63	6.88	12.09	14.29	26.38
	15 Kva.	658	3.29	3.49	4.32	16.02	11.10	27.12
	25 Kva.	408.5	2.04	5.24	2.31	20.48	9.59	30.07

•

Meter Installation Truck Has High Accessibility

Open at front and back and arranged with classified supply boxes to approximate a traveling stockroom, this meter installation truck of the Boston Edison Company is one of a group which speeds up installation work through the high accessibility of the material carried. Tools, meters, current transformers, fuses, wire and other supplies are stocked in systematically arranged containers of the removable type. The front end of the assembly is reached from behind the driver's seat and the rear end is open at the back of the truck as shown.

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for 25 Years!

Numerous solutions for eliminating insulator radio interference have been offered.

The *permanent* solution to this problem is now available.

Porcelain Products' TYPE N,* "Non-Radiating", insulators combine complete radio interference elimination *and* the long service life characteristics of standard insulators. TYPE N insulators are not affected by nitric acid or sulphur dioxide fumes; are absolutely non-porous and mechanically as strong as brown glazed units. *Only Type N insulators have these features!*

In any location where standard brown glazes are unaffected, Porcelain Products will unconditionally guarantee TYPE N insulators to retain their original interference-eliminating characteristics for at least 25 years.

See these new insulators. Test them. Put up a few and we know you'll want to standardize on them.

A note will bring samples and complete information. Porcelain Products, Inc., Parkersburg, W. Va.

* Patent applied for.

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INDUSTRIAL ENGINEERING

Infra-Red Oven Is Adaptable

By D. P. BROWN
Plant Engineer,
Canadian Westinghouse Company, Ltd.,
Hamilton, Ont., Canada

Lamp circuits of the infra-red drying oven installed in the Canadian Westinghouse plant in Hamilton, Ont., are so arranged that the oven is very flexible with regard to length of travel in the heat, the location of the heat zones and the possibility of varying the cross-section dimensions of the oven to suit the type and size of the articles treated.

The oven consists of a light latticed structure composed of 1-in. angle irons placed at intervals, across which are placed sheet metal wiring troughs. These troughs contain the wiring and at the same time support the gold-plated lamp reflectors—500 in all—placed in seven rows on each side of the oven and across the top. Along the top of the oven is a canopy or hood connected to an exhaust system, otherwise the oven is open into the room.

It is designed to bake or dry paint and enamel on such small articles as meter cases, small, medium and large switch boxes, small distribution transformer tanks, switchboard panels, power house operating desks, etc. In order to accommodate these articles, which vary in size and shape, the circuits are so arranged that a number of the lower horizontal rows of lamps may be switched off. A horizontal section of lamps part way up from the bottom on either side may be hinged upward and inward to reduce the height of the internal cross-section of the oven when small work is being baked. When this is done the several lower horizontal rows of lamps are switched off.

In conjunction with the oven there is an endless chain conveyor which passes through a spray booth, then through the oven, after which there is sufficient conveyor room to allow for cooling the work, unloading and reloading before the conveyor re-enters the spray booth. Conveyor speed is variable so that the time for a complete passage of work may be varied from four to 24 minutes.

Partial Operation

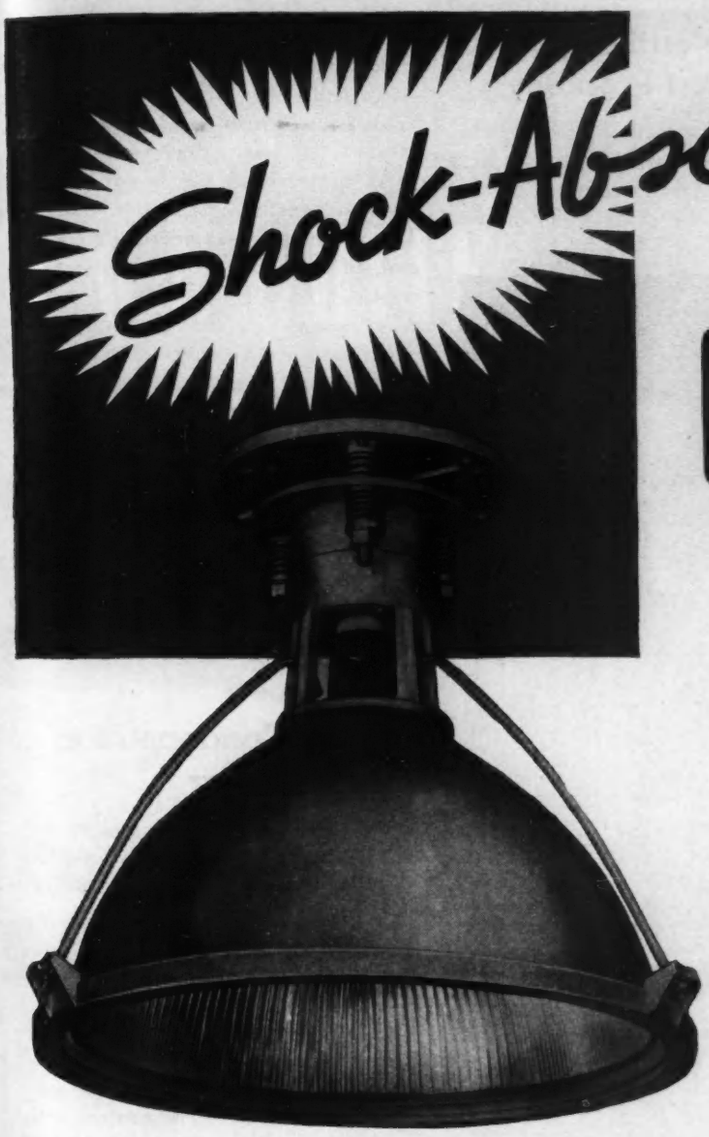
In addition, in cases where the work dries very quickly as it is put through, it is possible to switch off entire vertical sections of the oven. Then there may be articles which require a short time setting in the air before the heat is reached. In these cases a number of vertical sections at the entrance of the oven may be switched off, so that the work will travel a distance before it reaches the heat zone. Operating voltage is 110 at 60 cycles; "Nofuse" switches are used in the control.

The entire installation is inclosed in a glass-and-steel sash partitioned room into which is introduced filtered air at a slight pressure above atmosphere. This is done to prevent the entrance of dust-laden air from the forced ventilation in the spray booth or the fume exhauster over the oven. The air supply piping is so arranged that heated air may be drawn in from over the boilers in the adjoining boiler house during the winter or from the outside of the building in the summer.

Cost of the infra-red oven is ma-

Flexibility features infra-red drying oven in electrical manufacturing plant

Electrical equipment of various shapes and sizes is sprayed in the spray booth in the foreground and then passes through the banks of 500 infra-red lamps for baking or drying. Completed switch boxes may be seen on the conveyor at the right.



Shock-Absorbing HOLOPHANE CRANELITE

DEFIES VIBRATION AND DESTRUCTIVE "WHIP"

•

Special Construction Features

- **WIDE FLANGE**
  $10\frac{1}{4}$" steel plate maintains solid contact with crane
- **STEEL SPRINGS**
  Double action springs absorb shocks up and down, and in a lateral direction
- **EASY RELAMPING**
  is possible because of its position on catwalk
- **LIGHT UNDER CRANE**
  Ideal illumination for area directly below crane

For years power plant engineers have sought, for use under cranes, a lighting unit that would endure despite the most trying conditions of vibration and concussion. Holophane Cranelite No. 694 is that unit. It uses lamps from 500 to 1500 watts. It provides highly efficient illumination directly below the crane—safely, enduringly, and economically.

WRITE FOR FULL DETAILS AND ENGINEERING SPECIFICATIONS ON *CRANELITE NO. 694

(*Product of Holophane Research)

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COMPANY, INC.
Lighting Authorities—Since 1898
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NEW YORK CITY
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385 Yonge St., Toronto, Canada

terially less than a convection type. In addition, it reduces the drying time to about one-tenth that formerly required in the convection oven—ten minutes instead of 90. All of the previously used lacquers dry equally well in this new technique and the finish is better, because the convection type oven dried or baked the outside of the lacquer first and the inside last, while the infra-red rays penetrate to the metal surface, reversing the process and avoiding surface hardening.

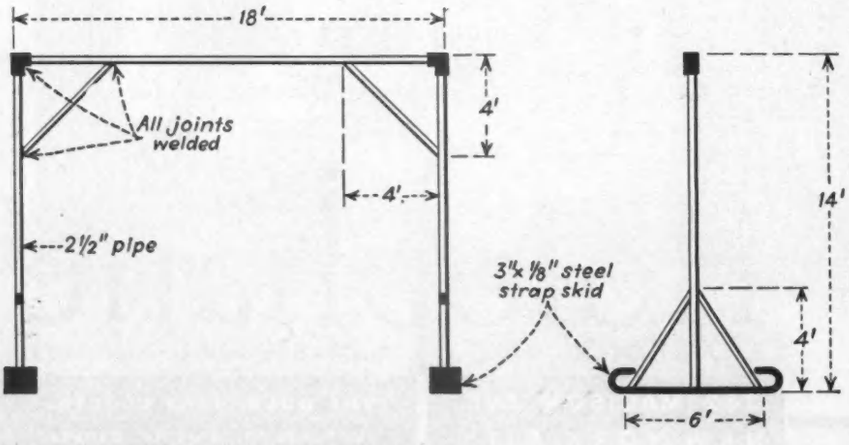
•

Arbor Supports Cable Over Roadways

In gravel pits, stone quarries, open-pit coal mines and on large construction operation, where portable high-voltage cables and trucks or tractors exist in combination, cables last much longer if some means can be found to keep mobile equipment from running over them. Furthermore, service to equipment will be more continuous.

At the Binkley Mining Company strip mines, outside Terre Haute, Ind., an arbor, shown in the sketch, is used to suspend cables and hose lines over roadways and truck routes so that loaded trucks can pass under the cable instead of over it.

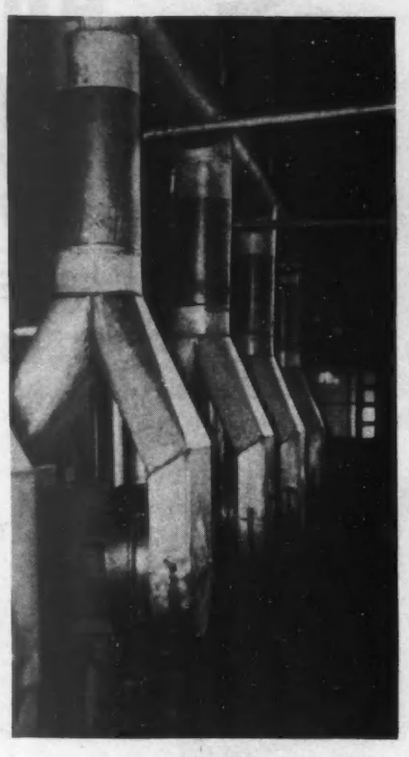
Although some may prefer to tie electrical cables to the arbor with twine or rope, metal hooks have been successfully used at the Binkley mines to hold the cable on the arbor. So that the arbors can be readily moved from place to place in the pit the arbor is mounted on steel skids turned up at the ends, to prevent catching on rocks and allow tow lines to be easily attached.



Support for portable cables avoids damage by trucks

Forced Ventilation Solves Dirt Problem

One low-cost method of combating air containing foreign matter detrimental to electrical equipment is now in use at a midwestern soy bean mill.



Low-cost ventilation scheme keeps oil vapor and dust deposits out of motors at soy bean mill

Here oil-laden vapor and dust, existing in combination around oil extractors, formed a muddy deposit in extractor motors, which not only clogged the motor air gaps, causing overheating, but also proved to be detrimental to insulation.

Short of installing all new completely-inclosed motors in the plant at considerable expense, the only means that could be found to combat successfully this menace was use of a ventilating system for the six 40-hp. motors involved, that would pass fresh air through the motors under pressure, excluding vapor and dust. This alternative was adopted recently and, to date, has proved highly successful.

As shown in the accompanying illustration, a sheet metal housing was built around the open end-bells of each motor and brought up to a common duct through which filtered outside air was forced by a centrifugal blower driven by a fractional-horsepower motor. Caps on the sheet metal housings permit access to the motors for inspection. Grease fittings for the motor bearing are brought out through the caps for convenience.

•

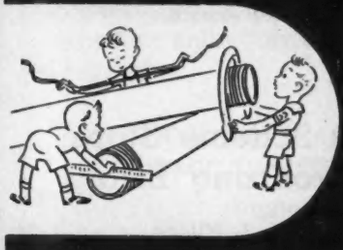
Prevent Condensation on Switchgear

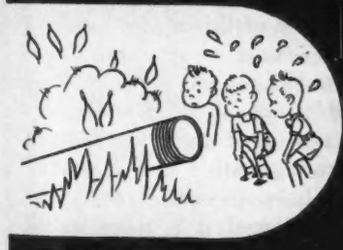
Strip-type electric heating elements are mounted on the inside of the 2,300-volt, 600-amp., metal-clad switchgear cubicles in a Southern paper-board mill to keep down the condensation caused by the humid atmosphere prevailing in this climate.

A single 500-watt unit has proved adequate for each cubicle; in all, eleven units, totaling 5,500 watts, are used in this manner. The heaters are connected across the 220 volts of the three-wire, 220/110-volt lighting circuit and controlled manually through an on-off switch. Elements are turned on during rainy spells and at times of sudden temperature changes.

Similar heaters are also placed under 2,000-hp. and 2,500-hp., 2,300-volt synchronous motors; three 250-watt heaters are used for each motor or a total of 1,500 watts for two motors. By means of extra, normally open interlocks on the main circuit breaker and auxiliary magnetic contacts, these heaters are interlocked with the motor control, so that they are automatically turned on when the motors are stopped and turned off when the motors are started. When the motors are shut down for any considerable period, such as week-ends, the motors are covered with canvas to retain the heat around the motor. Heaters are connected to the 220-volt control circuit of the motor cubicles.

FOR ENDURING SERVICE USE
G-E WHITE QUALITY CONDUIT





The high quality of G-E White Rigid Conduit makes it resistant to injuries of all sorts and gives it a long, dependable life. G-E White will protect wiring systems indefinitely.

Mild, "rimmed steel," an open-hearth product, is used which provides strong welds, and makes the conduit easy bending and clean threading.

Hot-dipped galvanizing and Glyptal coating inside and out provide lasting protection against heat, flame, acids, alkalies, moisture, etc.

All during the manufacturing process rigid specifications are followed closely. Only the finest of raw materials are used.

Here, indeed, is a conduit worthy of being installed where service conditions are toughest. A complete line of boxes and fittings are available.

For further information see the nearest G-E Merchandise Distributor or write to Section C-0131, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC

NEW ENGINEERING IDEAS

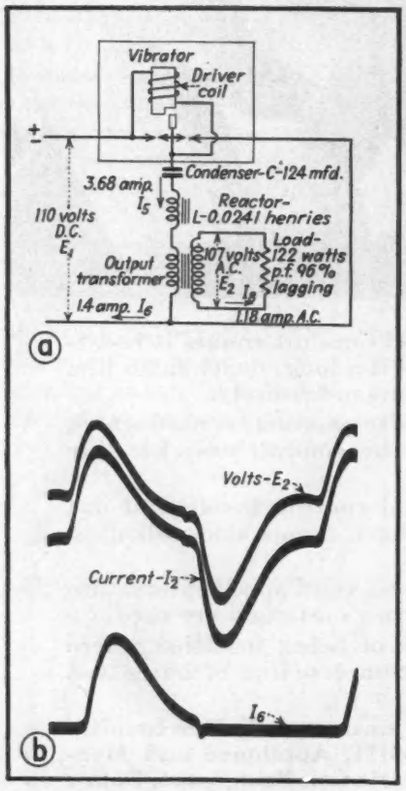
Inverter Avoids Contact-Sparking*

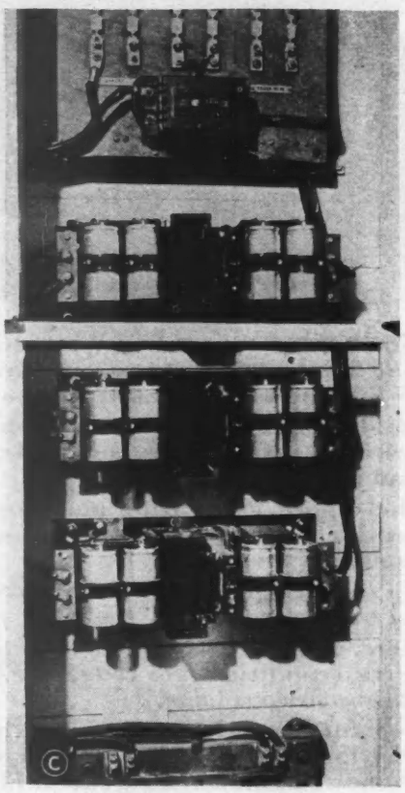
By O. KILTIE
General Electric Company, Fort Wayne, Ind.

By reducing the circuit current to zero before the vibrator contacts are allowed to open, improved reliability has been given to a new type of d.c. to a.c. inverter, with possible applications to utility short-wave radio systems and to fluorescent Mazda lighting on railway cars.

A.c. output of the inverter can be synchronized with an isolated a.c. power source by providing the driver coil of the vibrator with a suitable low voltage obtained directly from the synchronized voltage. D.c. supply current will reduce to zero if the vibratory reed should stop in any position of its normal operating range, while the d.c. line switch remains closed. Since the condenser becomes charged and remains charged, no current can flow. The battery or d.c. circuit is opened if the discharge contacts remain closed. For this development, the a.c. electrolytic type condenser has proved most suitable.

*Adapted from paper presented at San Francisco convention of A.I.E.E., 1939.





Improved reliability features new type of d.c. to a.c. vibrator inverter

Circuit constants of charge-discharge circuit (top left) are chosen so that load current will increase to maximum and decrease to zero during single closed period of one pair of contacts. Phase relation and comparison of output voltage and condenser current may be seen from oscillograms (left, bottom). Applied to fluorescent railway lighting (right), units supply 115 volts, 60 cycles, at a power factor of 80 per cent, from the usual railroad car d.c. supply of 32 volts.

•

Relay Scheme Stops Synchronizing Errors

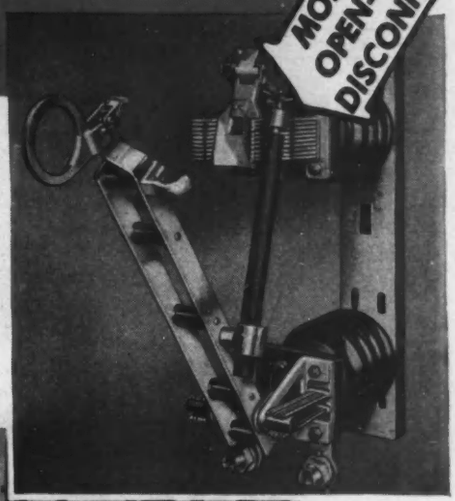
By E. F. MILLER
Engineer, Peoples Power Company, Moline, Ill.

Starting from the sound premise that a number of things can happen that could cause a generator unwittingly to be brought on the system considerably out of synchronism a scheme was worked out at the Riverside generating station that removes automatically an incoming generator from the system if it is more than 3 to 5 deg. out of synchronism.

At the Riverside plant the synchroscope is connected in circuit with the incoming generator by inserting and turning a key in a rotary type synchronizing switch located on the main control board. To the standard rotary type synchronizing switch has been added four contacts, designated contacts 6, 7, 8 and 9 on the sketch of switch development. It will be noted from the wiring diagram and development of the synchronizing switch that when the key is turned the current coils of the overcurrent relays are inserted in the current transformer secondary circuits.

If the oncoming generator should, through failure of potential fuses on the synchroscope or other cause, be brought on accidentally while out of synchronism the resulting current will trip the breaker and remove the

USE ONLY (3) KEARNEY BY-PASS DISCONNECTS INSTEAD OF (9) ORDINARY ONES ON JOBS LIKE THIS...



YOU'LL want to investigate these By-Pass Disconnects. They are being used to cut costs and simplify constructions all over the country. No longer need you face the problem of fitting equipment into your constructions which does not fully meet your satisfaction nor the requirements of the job. The new line of Kearney By-Pass Disconnects, you'll find, dependably meets factors of safety, cost and construction and effectively handles the job of disconnecting voltage regulators.

AND NOTE THIS EXAMPLE OF ECONOMIC CONSTRUCTION

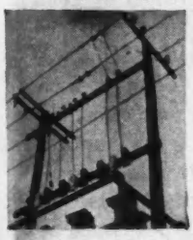


Figure 1 — Ordinary Disconnect Switches.

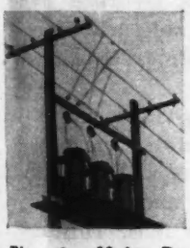


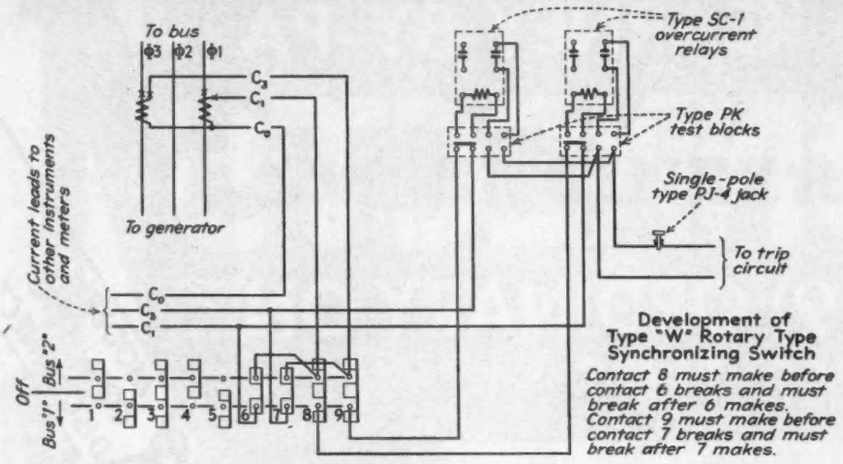
Figure 2 — Modern By-Pass Disconnects.

Figure 1 shows a platform installation of voltage regulators requiring (9) conventional switches. Figure 2 shows a similar three-phase installation using only (3) Kearney By-Pass Disconnects to handle the job safely, economically and efficiently.

But write today and ask about the other big advantages now made possible by modern Kearney open and closed type By-Pass Disconnect Switches.

Use **KEARNEY BY-PASS SWITCH**

MADE BY THE **JAMES R. KEARNEY CORPORATION**
4224-42 CLAYTON AVE. • ST. LOUIS, MO. • *Canadian Office, TORONTO, CANADA*


To bus
Φ3 Φ2 Φ1
C3
C1
C0
To generator
Current leads to other instruments and meters
Type SC-1 overcurrent relays
Type PK test blocks
Single-pole type PJ-4 jack
To trip circuit
C0
C3
C1
Off
Bus "2"
Bus "1"
1 2 3 4 5 6 7 8 9
Development of Type "W" Rotary Type Synchronizing Switch
Contact 8 must make before contact 6 breaks and must break after 6 makes. Contact 9 must make before contact 7 breaks and must break after 7 makes.

Relay scheme prevents generators from being "brought on" while out of synchronism

offending generator from the system automatically the factors of operation as to current value and to range of departure from synchronism depending, of course, on the setting of the relay.

If the generator is successfully synchronized the current circuit of the relay is disconnected when the synchroscope is de-energized; thus the relay is not affected by loading of the generator.

Inasmuch as this particular station has a double bus and it is sometimes necessary to transfer the loaded generators from the operating bus to the spare bus, thereby requiring that the synchronizing switch be turned to permit closing the spare bus oil circuit breaker, it was found necessary to provide a means of disconnecting the trip circuit of the overcurrent relays during this period of transfer, as the current coils of the relays are energized whenever the synchronizing switch is turned. To accomplish this a single-pole, plug-type switch was inserted in the trip circuit. This switch was located directly above the synchronizing switch and the plug is removed whenever such a transfer is required, thereby rendering the relays ineffective. In the scheme used at Riverside a type SC-1 relay is used and is set to trip at 400 amp. It has been found from experience that the operator must be within approximately 5 deg. either side of synchronism to keep from tripping the generator.

The method of operation in use at Riverside is as follows:

When a generator is to be brought on the line both the synchronizing key and the PJ-4 jack are inserted in their respective switches. The generator is then synchronized and brought on the line. Both the synchronizing key and the PJ-4 jack are now removed. If now for any reason it is necessary to insert the synchronizing key with the machine carrying load the PJ-4 jack is not inserted in its switch and there is, therefore, no danger of dropping a machine. Both the synchronizing key and PJ-4 jack are inserted each time a machine is to be brought on the line, and both are immediately removed once the machine has been synchronized.

•

Induction Currents for Surface Hardening

Surface hardening of steel parts by induction currents generated in the surface proper is a reported development of the Allgemeine Elektricitaets-Gesellschaft (AEG). The simplified process has first been used on crank shafts.

A single-winding induction coil, consisting of a double cylinder with a large number of water nozzles for tempering the steel when the hardening temperature has been reached, is placed over the pivots of the crankshaft, the coil being snapped over the pivot. Heating coil is fed with a high-frequency current of 3,000 cycles generated in a single-phase generator with from 450 to 600 volts and an output of 100 kva. Output and hardening time may be fixed individually for each "oven," the hardening process being almost automatic. "Ovens" have transparent hoods of "Astralon."

Hardening temperature is reached in four seconds and the tempering takes eight seconds; 40 crankshafts with eight bearings each can be hardened an hour by one man. Thickness of hardened surface layer may be preselected by changing the frequency of the current.

Full Stroke Lightning in the Laboratory

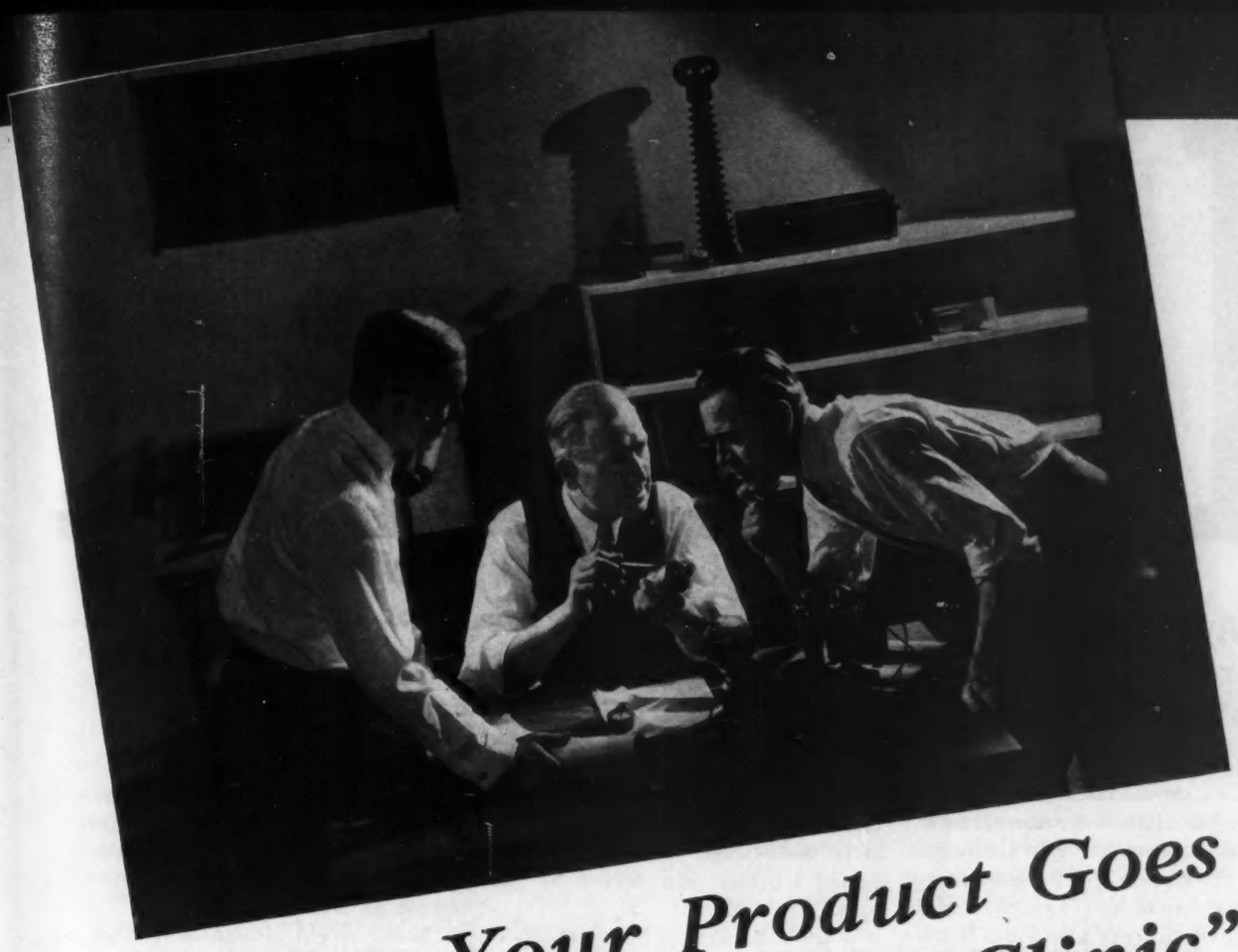
By P. H. McCAULEY
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

On June 10, 1939, a practically complete record of the current time relations in a lightning stroke which hit the University of Pittsburgh's Cathedral of Learning was made on the fulchronograph, which consists of a large number of magnetic links on a rotating disk. The maximum current was 20,000 amp., dropping to about 1,500 amp. in 100 microseconds and to 100 amp. in 10,000 microseconds.

Since this is the first complete record of lightning current duration, it has great significance in connection with the current capacity of lightning protective equipment. Although this one record may not be an "average" lightning stroke, operating experience indicates that it is on the severe side, for distribution circuits at least. Therefore, it was attempted to duplicate the wave in the laboratory. This was accomplished by combining two high-current surge generators to operate as a unit. One was arranged to give a 20,000-amp. wave lasting about 100 microseconds, the other was adjusted for a few hundred amperes with a duration of several thousand microseconds. Because the composite current wave developed by this duplex high-current generator closely resembles that recorded by the fulchronograph, the actual current in a natural lightning stroke is recorded.

To achieve the long-tailed current wave the surge generators were connected for 50,000 volts with a total capacity of 70 mfd. and available energy of 87.5 kw.-seconds. This is from 10 to 30 per cent more stored energy than has been reported for the larger high-current generators here and abroad. High available capacities were used to produce 1,000-amp. waves lasting several thousand microseconds rather than currents of 200,000 or 300,000 amp. for a few microseconds.

The current rose to 21,000 amp. in about 5 microseconds, dropped to 1,800 amp. in 100 microseconds and was 300 amp. at 2,000 microseconds. A resistance shunt was used to measure the current and the oscillograph deflection becomes very small beyond this time.



When Your Product Goes To The C-D *"Clinic"*

In one of this country's most advanced electro-physical laboratories hundreds of products have undergone "treatments" that affect their design, cost or performance—invariably for the better. Through tests and experiments backed by long experience with *all* types of insulation Continental-Diamond engineers can prescribe the one formula that will help solve the various problems involved, enabling you to do a better manufacturing job at lower cost . . . This research service is at your disposal without fee or obligation . . . A letter stating how we can best serve you will make the next move ours—write today.

CONTINENTAL-DIAMOND FIBRE CO., NEWARK, DEL.

C-D Products

DILECTO—A laminated plastic possessing unusual insulating and mechanical properties.

DIAMOND vulcanized **FIBRE**—A tough, hard, bone-like material of high dielectric strength.

CELLULAK — A specially laminated tubing with high dielectric strength and resistance to flashover.

VULCOID—A laminated fibrous base material highly resistant to atmospheric conditions and moisture.

MICABOND — Has all the good qualities of mica plus adaptability. Sheets, rings or formed parts.

CELORON—A molded phenolic fabric base material of exceptional mechanical strength yet very light in weight.

LOAD BUILDING

Six Applications in Greenhouse Load

By J. C. SCOTT
Agricultural Engineer,
Puget Sound Power & Light Company, Seattle

Beall's greenhouses, located in our Vashon Island territory, cover seven acres, specializing in the large-scale production of high-quality roses, gardenias and orchids. This year 5,000 gardenia plants are being grown at a time.

Extent of electrical usage can be gauged from the fact that Beall's spends $100 per month for electricity for soil heating alone. During a three-month period when there was little sun the cost of supplementary light and heat averaged $30 per month. In addition, new usages include widespread application of fans and installation of fluorescent lights for grading.

Originally done by steam, soil sterilizing has been extended since electrical methods were adopted, until now the soil sterilizers are in fairly constant use through nine months of the year. All soil used in these greenhouses is sterilized before replanting.

Sterilizers consist of electrode plates forced into the soil. Six plates, placed 16 in. apart, are made into one section which covers the width of a bed. Four sections are connected together and served at 220 volts.

While a battery of four sections is working in one location, another battery is being made ready in another part of the bench. At the end of 1¾ hours the first battery has completed its job of sterilizing 173 sq.ft. and the load is transferred to the other.

Considering labor, Bealls has found it can sterilize by electricity at half the cost of steam, or 1½ cents per sq.ft., as against 3 cents.

The use of 150 small fans has proved so effective that an installation of 168 more is planned. The fans help prevent plant diseases by eliminating stale-air pockets in the greenhouses. In addition, the fans permit better control of humidity and are believed to lead to better action of plant chlorophyl.

Other electric usages include refrigeration of a 20x20-ft. room for cooling and holding flowers, operation of 8,000 watts of Mazda lamps for forcing blooms and operation of power sprayers which are moved about as needed.

Most recent installation was a daylight fluorescent lamp for grading flowers. The unit has proved so satisfactory that all grading-room lights are being changed to daylight-fluorescent type.

Soil sterilizers consist of plates driven into the soil—six plates make a section and four sections are operated together—costs are halved

•

Better Lighting From Fluorescent Lamps

By ROY A. PALMER
Illuminating Engineer,
Duke Power Company, Charlotte, N. C.

In full-fashioned hosiery mills the problem of seeing is quite critical due to the necessity of discerning fine detail both in the observation of the product during the various processes and also the adjusting of various parts of the machines. A general lighting system has usually been the practice in lighting this type of work and in most cases has been fairly satisfactory. However, the illumination levels have rarely exceeded 20 ft.-candles, and in the majority of cases are considerably less. Some mills have utilized local lighting systems, but due to poor design of both equipment and system and, in some cases, insufficient wattage, such installations have been quite unsatisfactory. Both the local and the general lighting systems, then, have not

for '40!

FRIGIDAIRE

NEW Design and Color Harmony! NEW Convenience Features! NEW Low Prices!

America's No. 1 Refrigerator Leads Again!

● Does it have "that golden touch"? There isn't a single doubt!

It's big, it's beautiful, it's a bargain, this glamorous new Frigidaire. A stunning creation of master craftsmanship and engineering skill.

Eye-capturing is the cabinet exterior of rich new beauty . . . clean, appealing design! And what a picture inside! An artist's genius come to life! An exquisite color harmony of bright blue, dazzling white and glittering gold! Shining stainless chromium shelves . . . a new, extra-large Meat-Tender . . . Glass-Topped Hydrators! A jewel-like interior of convenience that will delight every woman who sees it!

And the beauty and value are more than meet the eye. Deep in the heart of this sturdy, one-piece steel cabinet, is the Meter-Miser, further improved for 1940...quietly and efficiently keeping food safer and freezing ice faster at *the lowest current cost in Frigidaire history!*

Yes, the new 1940 Frigidaire Refrigerator, backed with far-reaching and thorough selling support of all kinds, is as "good as gold" in the pockets of Frigidaire selling men. No wonder that, from coast to coast, the news is out: "It's Frigidaire for '40!"

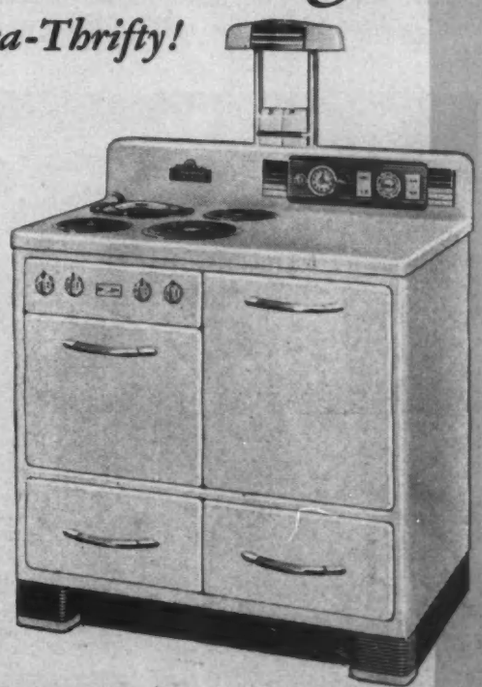
Sensation of the Industry — New Frigidaire Electric Range

Extra-Fast! • Extra-Sure! • Extra-Thrifty!

● Nine beautiful 1940 models include a new top-quality range equipped with two ovens . . . a traffic-building, sensationally low-priced cabinet model...and a new combination electric range and kitchen heater.

New features include a **New Simpli-Matic Oven Control** that provides super-fast pre-heating, then *automatically* switches to proper baking temperature...a **Thrifto-Matic Switch** on the rear surface unit and Thermizer well-cooker that *automatically* turns from high to low heat when desired . . . **New Signal Lights** that glow whenever any surface or oven heat is turned on . . . and efficient **Cooking-Top Lamp** on every household model.

We say with confidence that, with its many selling advantages, the new 1940 Frigidaire Electric Range will exceed the sales and profit expectations of every Frigidaire selling man!



New 1940 FRIGIDAIRE ELECTRIC WATER HEATERS

● The Frigidaire Water Heater line now includes a handsome "Super-Value" model selling at the lowest price ever placed on a Frigidaire Electric Water Heater. Opens up great new sales opportunities. There are also beautiful new De Luxe Cabinet models, and a trim Table Top model (36" high).

FRIGIDAIRE DIVISION • GENERAL MOTORS SALES CORPORATION • DAYTON, OHIO

Light on the knitting machines—Large area light sources minimize shadows and flood every detail of work and machine with eye-easy illumination

fulfilled all of the requirements of good seeing conditions.

A recent installation of more than 470 fluorescent lamps at the Hudson silk hosiery plant in Charlotte, N. C., is a distinct step forward in providing excellent seeing conditions at the critical operation points on the machines. An average of 50 ft.-candles is provided at the needle points on the full-fashioned machines. Miller-Ivanhoe lighting units equipped with 36-in. Daylite fluorescent lamps are placed over the 48 full-fashioned knitting machines in the mill. The units are mounted 42 in. above the needle bars and are spaced 33 in. apart from end to end or 6 ft. on centers over the 26-section machines. At this spacing the light is uniformly distributed over the machine. The length of light sources makes a minimum of shadows, which is important when the operator is locating threads or otherwise adjusting the machine. While the lighting in the mill is derived solely from this system, which can in reality be called a local lighting system, there is a sufficient amount of reflected light to illuminate the ceiling and thereby relieve any excessive contrast and also to provide a pleasant atmosphere in the room. The fluorescent lamps in this case are particularly advantageous because of the coolness of operation, which is assurance against excessive heat on the operators as they are working on the machines. In the manufacture of silk hosiery color discrimination is not important. Therefore, the daylight color quality of the fluorescent lamp has no particular advantage, but the psychological effect on the workers is very favorable.

In addition to the units over the full-fashioned knitting machines there are some 70 units installed in the throwing room. All of these lamps throughout the mill are operated an average of 100 hours a week. Obviously the splendid seeing conditions, the pleasing atmosphere created by this lighting in the room and coolness of the lamps create a very pleasant working condition for the operators and an economical and practical installation from the standpoint of the owners. Incidentally, this mill is a windowless building completely air conditioned throughout, with a cork-insulated roof and other modern features.

A uniform intensity of 20 ft.-candles is obtained from completely diffused light in the office of Johnson Wax Company in Racine, Wis.

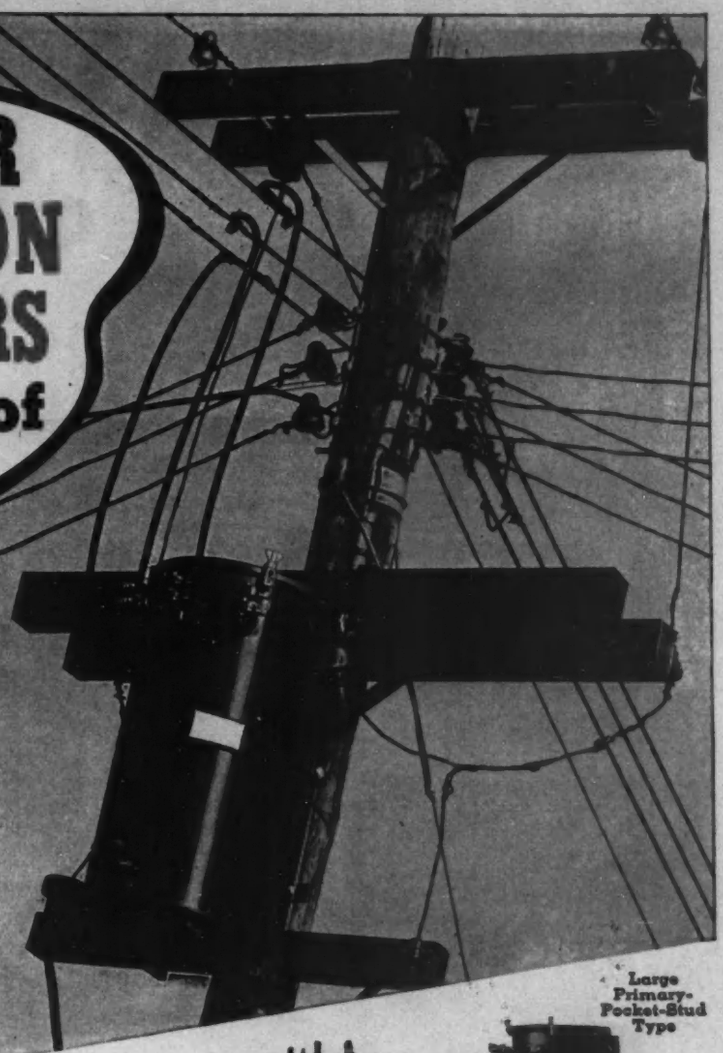
•

Electric Enameling Cuts Wire Costs

A New England manufacturing plant formerly baking enamel on small sizes of wire by gas pipe burner heating substituted an electric heating installation of 22 kw. rating for this work, and in addition to improving the atmospheric conditions and setting up a more stable production from the quality standpoint secured reductions in cost per hundred pounds of wire heated ranging from 4 to 29 cents. Operating temperatures, 450 deg. C., were the same in each case. The results are tabulated below:

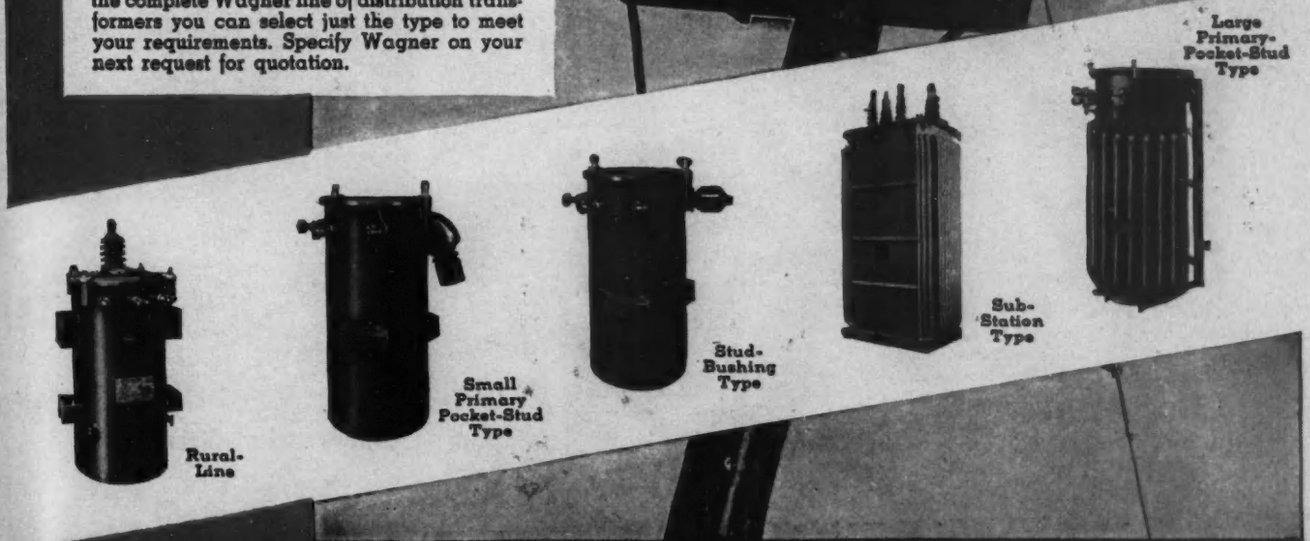
	Gas	Electricity
Insulation	85% magnesia	Silocel
Heating unit	Pipe burner	Nichrome wire
Rating	.....	22 kw.
Operating temperature deg. C	450	450
Cost of gas per M cu. ft.	47 cents	.....
Cost of electricity per kw.hr.	.....	0.75 cent
Cost per hundred pounds of wire		
Size 0.0085	$1.35	$1.06
Size 0.0103	0.84	0.72
Size 0.014	0.55	0.51

WAGNER DISTRIBUTION TRANSFORMERS for Every Type of Service —



No matter how varied your requirements may be, the Wagner line of distribution transformers will meet those requirements. Wagner distribution transformers range from the small 100-va air-cooled transformer to the large sub-station type, and the same high quality goes into the construction of each one.

Every Wagner transformer has the benefit of nearly 50 years of transformer engineering experience . . . experience in building all types of transformers. The value of this experience is demonstrated by the actual performance of Wagner transformers in service. In all parts of the country Wagner transformers are hanging up records for continuity of service. From the complete Wagner line of distribution transformers you can select just the type to meet your requirements. Specify Wagner on your next request for quotation.



In addition to the complete line of distribution transformers Wagner builds power transformers in all sizes and ratings. For complete descriptive literature on the design and construction of Wagner transformers, write for Bulletins 180 (Distribution) and 181 (Power).

T-6-3

Wagner Electric Corporation

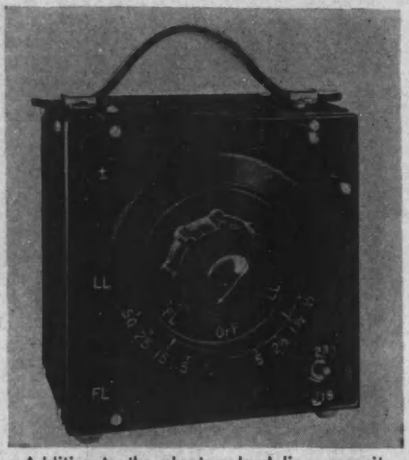
6400 Plymouth Avenue, Saint Louis, Mo., U.S.A.

TRANSFORMERS • MOTORS • FANS • BRAKES

NEW EQUIPMENT

Portable Phantom Load

The load is provided with a full load-light load switch, which permits shifting from full load to light load and vice versa without turning the main rotary switch. When the rotary switch is set for the desired full load value, the light load set-



Addition to the phantom load line, capacity 50 amp., 115-230 volts, designed to carry current for testing watt-hour and demand type meters; weight 9¾ lb., 6⅞x6½x5½ in. The States Co., Hartford, Conn.

ting is made automatically. To make a light load check, turn the FL-LL switch to the "LL" position, this operation manually shifting the load value and also shifting the connections from the full load to the light load coil of the test meter. This load is adaptable for use in test kits.

•

Insulation Tester

"Vibrotest" insulation testing instrument, a.c.-d.c. voltmeter, megohmmeter, ohmmeter. Associated Research, Inc., J. W. Murphy Co., 16 North May St., Chicago, Ill.

Instrument is D'Arsonval moving coil type of movement with chrome steel magnet. Megohm scale calibrated 0–200 and ohm scale ¼–2,000 ohms. Three d.c. voltage ranges are standard on this instrument, 0–150, 0–300 and 0–600 volts. A.c. ranges are 0–150, 0–300 and 0–600 volts. The push button is used only when testing with the ohm or megohm portion of the instrument. In addition to providing a means of standardizing the voltage required for these tests, the push button also serves as a means of discharging any electrostatic capacity that may have been built up in the equipment. Discharge of the circuit takes place when push button is released upon completion of resistance readings.

•

Copper Braid

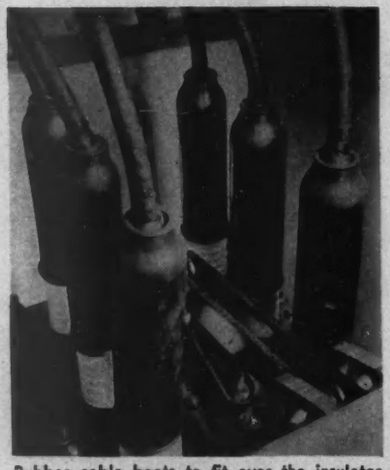
Insulated flexible copper braids, furnished in various ampere capacities. Burndy Engineering Co., Inc., New York, N. Y.

Only the ferrule ends of the flat, flexible copper braids, completely insulated with rubber, are left bare for clamping to terminal blocks. This type of braid finds use for connections between moving parts in inclosed equipment or where the braid may be exposed to accidental contacts.

•

Cable Boots

Short circuiting of light and power lines by rats coming in contact with cables attached to oil circuit breakers in the power house may be overcome by the use of these molded rubber cable boots.

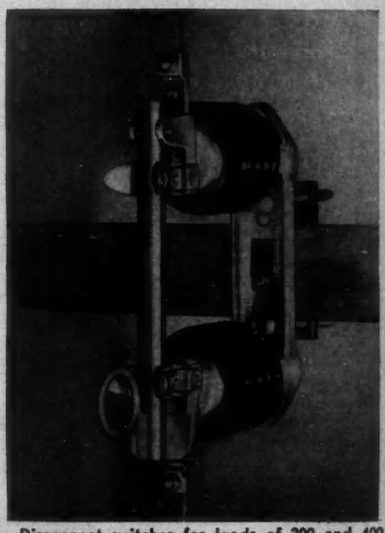


Rubber cable boots to fit over the insulator and up on the cable, covering the latter to a point beyond the reach of rats. United States Rubber Co., 1790 Broadway, New York, N. Y.

BUYING ELECTRICAL EQUIPMENT?—"Electrical World" *Electrical Buyers Reference* is a convenient place to look first for names, addresses and products of manufacturers.

Disconnect Switch

The 200-amp. switches have line type contacts at each end of the blade, while the 400-amp. units use strong point pressure contacts at both ends of the blade.



Disconnect switches for loads of 200 and 400 amp. and for voltages through 15,000. James R. Kearney Corp., St. Louis, Mo.

Both types are equipped with sub-N.E.M.A. station post type insulators and they both have locks to hold the blades closed against magnetic or gravitational pulls.

•

Coil Winder Drive

Model 210 coil winder drive with driving speeds between 120 r.p.m. and 650 r.p.m. Ideal Commutator Dresser Co., Sycamore, Ill..

Besides the braking and running positions, there is a neutral position secured through the foot pedal to allow for turning the machine by hand. A revolution counter records by addition or subtraction the total number of turns. A pilot light indicates whether the 1/3-hp. motor is running.

•

Control System

Essentially the "Reactrol" system consists of a control panel, a temperature or pressure control instrument and a saturable-core reactor. In operation, the pressure or temperature control instrument feeds low-voltage current into an amplify-

IRCE NO.1358 RACKS

HAVE WADED THROUGH

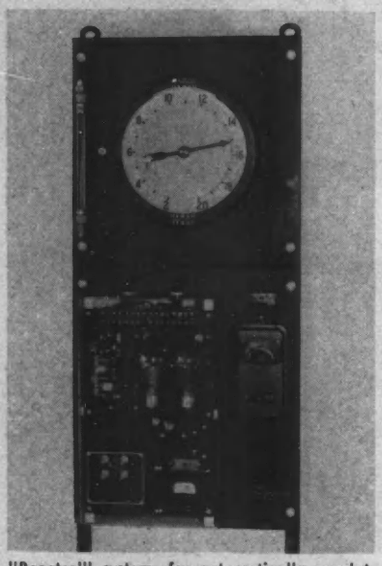
COUNTLESS HAZARDS FOR MANY DECADES—AS ORIGINALLY DESIGNED—STILL PROVIDING THE ULTIMATE IN SERVICE AND THE MINIMUM IN MAINTENANCE—TRIUMPHANT IN THE FACE OF COUNTLESS IMITATIONS.

HUBBARD AND COMPANY

PITTSBURGH OAKLAND CALIFORNIA CHICAGO

HANG THE LOAD ON HUBBARD HARDWARE"

ing tube on the control panel. This tube, in turn, regulates the flow of direct current to the saturable-core reactor, which regulates the voltage supplied and thus the amount of power going to the electric heating system. This system is particularly suitable for continuous processes and in the treatment of materials that might be affected by slight changes in temperature.

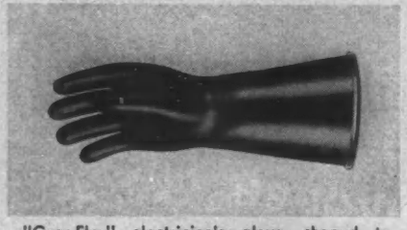


"Reactrol" system, for automatically regulating the power input to electrically heated equipments, such as furnaces, boilers, superheaters and air heaters. **General Electric Co.**, Schenectady, N. Y.

•

Electrician's Glove

The company claims that this glove will withstand repeated electric tests over long periods and have high resistance to current leakage even after soaking in water. The



"Curv-Flex" electrician's glove, shaped to fit the hand. **Miller Rubber Co.**, Akron, Ohio.

new design is shaped to the contour of the hand with specially designed fingers, wrist and cuff. The gloves are made by the anode process.

•

Ear Protector

M.S.A. Welders' ear protectors. **Mine Safety Appliance Co.**, Braddock, Thomas & Meade Sts., Pittsburgh, Pa.

A simple and practical device for preventing injury to the ears by entry of flying sparks or hot metal particles, consisting of two ear protectors made of a close-woven, non-rusting screen with leather binding held in place over the ears by an adjustable spring steel headband.

•

Dead-End Clamp

Designed to eliminate cocking of clamp under load and with jumper definitely carried away from incoming conductor

Clamp No. 4038, with center of clevis ears in line with conductor; weight 1¼ lb., for use with copper or copperweld conductors in diameters of 0.185 to 0.375 in., inclusive. **Porcelain Insulator Corp.**, Lima, N. Y.

and clamp. Large area of gripping contact and no loose keeper parts guarantee long service life. Made from electric furnace annealed malleable iron with forged steel keeper bolt, all hot dip galvanized.

•

Electric Power Control

For manual adjustment of a.c. voltage in electrical testing and for control of heating, lighting or line voltage, these variable transformers offer output voltages continuously adjustable from zero to above line voltage.

"Powerstat" variable transformers are available in sizes from 2 to 25 kva. for 115, 230 or 400-volt circuits. **Superior Electric Co.**, Bristol, Conn.

•

Prefinished Metals

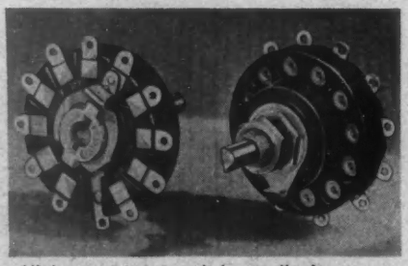
Nickel aluminum and chrome aluminum sheet for reflectors. **American Nickeloid Co.**, Peru, Ill.

These two new metals consist of surfaces of pure nickel or chromium bonded to an aluminum base. Available in sheets 24 x 96 in. to 36 x 96 in. in gauges from 0.010 in. to 0.0625 in. Adaptable to reflectors because of light weight, workable, corrosion and wear-resistant characteristics, the company claims.

•

Tap Switch

This switch is a multi-point, load-break, non-shorting, single-pole rotary selector, particularly designed for alternating-cur-



High current tap switch, small size, open type, Model 111, available in ratings from 5 amp., 120 volts, to 75 amp., 240 volts. **Ohmite Mfg. Co.**, 4835 Flournoy St., Chicago, Ill.

rent use. All-ceramic in construction, compact and well insulated, having silver-to-silver contacts. Positive cam-and-roller mechanism is claimed to provide "slow-break," quick-make action for alternating current — minimizes sparking — increases the life of the contacts. May be used for radio transmitters, switchboards, heater or oven control, arc welders, spot welders, battery chargers, motor control, tapped transformers, etc.

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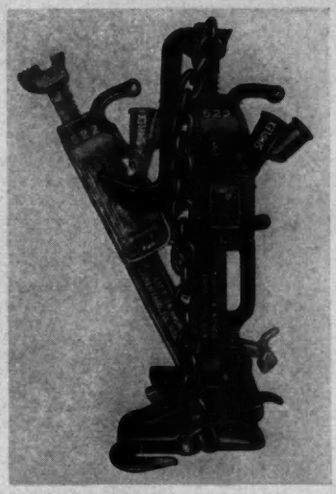
Emergency Jack

This jack is identical to the Simplex No. 310A emergency jack which has a 15-ton capacity. The jack tilts on its base when



"No. 522," light-weight, single-acting, automatic raising and lowering emergency jack. **Templeton, Kenly & Co.**, 1020 S. Central Ave., Chicago, Ill.

the pawl is disengaged, permitting angular jacking or pushing and pulling. It weighs 64 lb., is 22 in. high and has a 14-in. lift.

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TECHNICAL LITERATURE

N.E.M.A. STANDARDS — "Laminated Phenolic Products" No. 39-57 and "Recommended Practice for Machining and Punching Laminated Phenolic Plate" No. 39-58. The former is a revision of that issued in 1934. It contains a general description of laminated phenolic manufacture, description of twelve grades of laminated phenolic plate and nine grades of tubing, standard colors of plates, sizes and finishes, standard tolerances and physical and electrical properties of the various grades. The latter paper includes information on sawing, drilling, tapping, threading, milling, turning, punching, shaving and shearing of the various grades of laminated phenolic plate. Copies are available from National Electrical Manufacturers Association, 155 East 44th Street, New York, N. Y., for $0.25 and $0.10 respectively.

ELECTRIC HAZARD IN FIRES—Gives tables of distance which a nozzle should be kept from the electrical line or device and outlines varying conditions applying to voltages, hose streams, hand fire extinguishers and the hazards to be avoided in their use. Bulletin No. 91, "Fire Streams and High-Tension Electric Lines," may be obtained from National Board of Fire Underwriters, 85 John Street, New York, N. Y.

LINEMAN
LABORATORY
"Curv-Flex are comfortable because they are shaped to fit the natural contour of the hand."
"The greater flexibility of Curv-Flex reduces hand fatigue, too."
"You can't beat Curv-Flex Gloves for tear and snag-resistance."
"Curv-Flex are always uniform in size, gauge and shape."
"Curv-Flex offer high resistance to current leakage, even after water soaking."
"Curv-Flex have proven their ability to stand repeated electric tests over long periods."

NEW "Curv-Flex" Electrician's Gloves Combine Greater Comfort with Proven Safety and Economy

Here's an important addition to the famous Miller line of Anode Latex Electrician's Gloves. It's the new Curv-Flex—not just another curved finger glove but one that is *scientifically designed* in *fingers, wrist* and *cuff* to afford greater freedom and comfort.

Use of Curv-Flex likewise assures greatest safety and economy because, like all Miller Electrician's Gloves, they are made by the Anode process. Anode Latex gloves offer high resistance to current leakage; will withstand repeated electric tests over long periods. They have greater tensile strength with which to resist tearing and snagging; possess long aging qualities; are highly flexible and more uniform in thickness.

With all these added advantages, Curv-Flex Gloves cost no more than those of equal specifications. They are available in 14″ length with rolled bead cuff in sizes 10, 10½ and 11.

For prices and complete information on either the new Miller Curv-Flex or straight fingered Anode Latex Electrician's Gloves, write—

MILLER RUBBER COMPANY, INC., AKRON, OHIO • *"Engineers in Rubber"*

Miller ANODE LATEX ELECTRICIAN'S GLOVES

NEWS ABOUT PEOPLE

New Haven Utility Elects Three Vice-Presidents

United Illuminating Co., New Haven, Conn., has announced some important changes in its official set-up. Robert A. Manwaring, formerly general manager of the company; C. A. Williams, formerly secretary and treasurer, and Richard H. Van Horn, formerly chief engineer, have been elected vice-presidents. A. Royal Wood, formerly employed by the accounting firm of Lybrand, Ross Bros. & Montgomery of New York and Boston, becomes secretary and treasurer.

Mr. Manwaring, a veteran employee of the company who joined the organization 54 years ago, will devote his time to general duties. He has been designated as first vice-president.

R. A. Manwaring

Mr. Williams will have charge of distribution and sales. He was educated at the University of Washington and Massachusetts Institute of Technology, being graduated from the latter in electrical engineering in 1921 and receiving a master's degree in 1922. He was connected with the engineering department of the Philadelphia Electric Co. for about two years; taught at the Drexel Institute, Philadelphia, and was engaged in public utility research for a time at the Harvard Graduate School of Business Administration. He then joined the commercial and industrial department of the then Tenney group of utilities at Boston, later becoming manager and specializing in rate problems and regulation. Then he joined the New England Power Association as rate engineer, and about a year ago went to New Haven in connection with the new administration of the United company.

Mr. Van Horn, who joined the company in 1928, will be resident in Bridgeport and will have charge of production and engineering of the whole company.

Mr. Wood, though a newcomer, is not a stranger, because since early in 1939 he has had charge of the installation of the company's new billing and accounting system. J. M. C. Betts has been appointed to assist Mr. Wood.

Edward H. Walton, formerly associated with the New Jersey Power & Light Co., will be connected with United Illuminating Co. in Bridgeport, where he will assist Walter Upham, superintendent of distribution.

R. H. Van Horn

C. A. Williams

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J. E. Carnes Made Manager of Nashville Properties

James E. Carnes, for many years connected with the Tennessee Electric Power Co. until the sale of that company to the Tennessee Valley Authority and municipalities, has been appointed general manager of the Nashville Electric Service, succeeding the late John P. W. Brown.

Mr. Carnes had been assistant to Mr. Brown since 1919, as assistant general superintendent of the Nashville Railway & Light Co. He began work in the light company at Nashville in 1904, and in the course of his association with the company had served in many departments. At the time Tennessee Electric Power was sold he was assistant to the vice-president and general manager at Nashville. Mr. Carnes had served as a director of the Tennessee Electric Power Co. and of the Tennessee Transportation Co.

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► F. A. Robbins of the Superior Water, Light & Power Co., Superior, Wis., has recently assumed responsibility for the

ORANGEBURG HAS *long* BEEN PART OF

© Fairchild Aerial Surveys, Inc.

Beneath the gayety and charming hospitality of the world famous Mardi-Gras, New Orleans has built a modern, efficient underground distribution system which overcomes seemingly insurmountable handicaps.

Whether installed and handled on the hottest deserts or in the bitter cold within the Arctic Circle, whether buried in the corrosive backfill of seaside tidewater conditions, or in cinder fill, even when subjected to wide, seasonal variances, and hasty installations working against time . . . under every conceivable condition, Orangeburg Conduits have economically and completely met the test of decades of time.

Just another of the **"ORANGEBURG Points That Count"**

The Orangeburg trademark is a guarantee of the best of Fibre Conduits, a time-tested, enduring "service" of cable protection wherever electrical raceway facilities are to be installed underground.

● Installed *below sea level* in many parts of a city protected from the ravages of the Mississippi by a unique levee system, New Orleans' underground distribution system is exposed to the animal, vegetable and fungus conditions that flourish in subtropical lowlands. As Orangeburg is immune to these hazards and gives 100% cable protection it can be counted upon for scores of years of trouble-free service.

Constant improvements add materially to trouble-free expectancy . . . and maintain Orangeburg's outstanding leadership in the field. And Orangeburg economy points cut material and installation costs by as much as 50%.

For installation underground with CONCRETE ENCASEMENT: ORANGEBURG STANDARD FIBRE Conduit is recommended for duct banks (4 ducts and over), main distribution, high tension and "downtown" locations.

For installation WITHOUT CONCRETE ENCASEMENT: the Orangeburg dual-economy NOCRETE Conduit is recommended for service entrances, extensions, parkways and street lighting, suburban distribution, laterals, singal systems, etc.

Sales Agent—Distributors

GENERAL ELECTRIC SUPPLY CORP.

GRAYBAR ELECTRIC COMPANY INC.

MADE AT ORANGEBURG, NEW YORK
BY THE FIBRE CONDUIT COMPANY
292 MADISON AVE. NEW YORK CITY

ORANGEBURG ***Standard*** **for installation** ***with*** **concrete encasement**
NOCRETE for installation ***without*** **concrete encasement**

"MEGGER"

"We have been using a 'Megger' Insulation Tester for the past 29 years with perfect results"

SAYS AN ENGINEER IN A LARGE UTILITY CO.

STATEMENTS such as the above are neither unusual nor exaggerated, because many of our "Megger" Instruments have been in service for more than 25 years. The astonishing ruggedness and long-time reliability of these devices are outranked only by the increasingly vital importance of the "Megger" Insulation Resistance Test.

●

And for your measurements of ground resistance, our "Megger" Ground Testers have the same qualities of simplicity, reliability and ruggedness.

Write for—

Catalog 1550-W on "Megger" Insulation Testers

Catalog 1425-W on "Megger" Ground Testers

JAMES G. BIDDLE CO.

ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

general engineering work of the electric, gas and water utilities of the company. G. A. CORINE will be general superintendent in charge of all of the operating facilities of the company and HARVEY C. SARGENT will be electrical superintendent.

▶ WILLIAM H. OTT, head power salesman and veteran of 40 years with Commonwealth Edison Co., retired from service with the company November 30. Mr. Ott started in the employ of the Edison company in 1899 when he entered the contract department as a lighting solicitor. He became a power solicitor three years later and was appointed head power salesman in 1914.

●

Schmitt Assumes Broader Duties with Emerson

Emerson Electric Manufacturing Co., St. Louis, announced the election of Oscar C. Schmitt as executive vice-president. Mr. Schmitt was formerly vice-president in charge of sales.

A native of St. Louis, Mr. Schmitt has been connected with the Emerson Electric organization since 1910. Advancing gradually to positions of responsibility, he was appointed assistant manager of the special motor division in 1927 and two years later manager of the specialty sales division.

In 1932 he became advertising manager of the company and from 1934-36 served as sales promotion manager in charge of the fan sales division and advertising division. His election as

vice-president in charge of fan sales and advertising followed, and last year he assumed the duties of vice-president in charge of fan and motor sales.

Raymond E. Otto, manager of motor sales, has been promoted to the position of manager of sales, and William R. Fraser, district manager, New York City, to manager motor sales, located in St. Louis.

Youngholm Elected Head Electric-Gas Association

David S. Youngholm, vice-president of the Westinghouse Electric & Manufacturing Co., was elected president of the Electrical and Gas Association

of New York, Inc., at the annual meeting held last week.

Other officers elected by the association were: J. H. McKenna, Knapp-Monarch Co., first vice-president; Clifford E. Paige, Brooklyn Union Gas Co., second vice-president; T. F. Barton, General Electric Co., third vice-president; Leslie C. Boyd, Van Cortlandt Appliance Corp., fourth vice-president; S. J. O'Brien, S. J. O'Brien Sales Corp., treasurer; Harry C. Calahan, General Electric Supply Corp., secretary, and James W. Carpenter, Long Island Lighting Co., assistant secretary.

●

▶ RAYMOND C. COSGROVE, long associated with the Westinghouse Electric & Manufacturing Co., Pittsburgh, has been named a vice-president of the Crosley Corp., Cincinnati, and general manager of the manufacturing division. Powel Crosley, Jr., president of Crosley, remains active in his direction of the general policies of the corporation, and Lewis M. Crosley, brother of the president and long active in the management of the corporation, continues as executive vice-president. Mr. Cosgrove will in his new affiliation be in direct charge of the engineering, production, distribution and sale of Shelvador refrigerators, radios, electric and gas ranges, washing machines and ironers and the new Crosley automobile.

▶ LARNED A. MEACHAM of the engineering staff of the Bell Telephone Laboratories has been chosen to receive the recognition of outstanding young electrical engineers, which is awarded annually to the leading younger men in

the industry by Eta Kappa Nu, honorary electrical engineering society. Honorable mention awards were also made to CARL K. GIERINGER, chief engineer of the Liebel-Flarsheim Co. of Cincinnati, and Dr. HESSE E. HOBSON of the Westinghouse Electric & Manufacturing Co. of East Pittsburgh.

OBITUARY

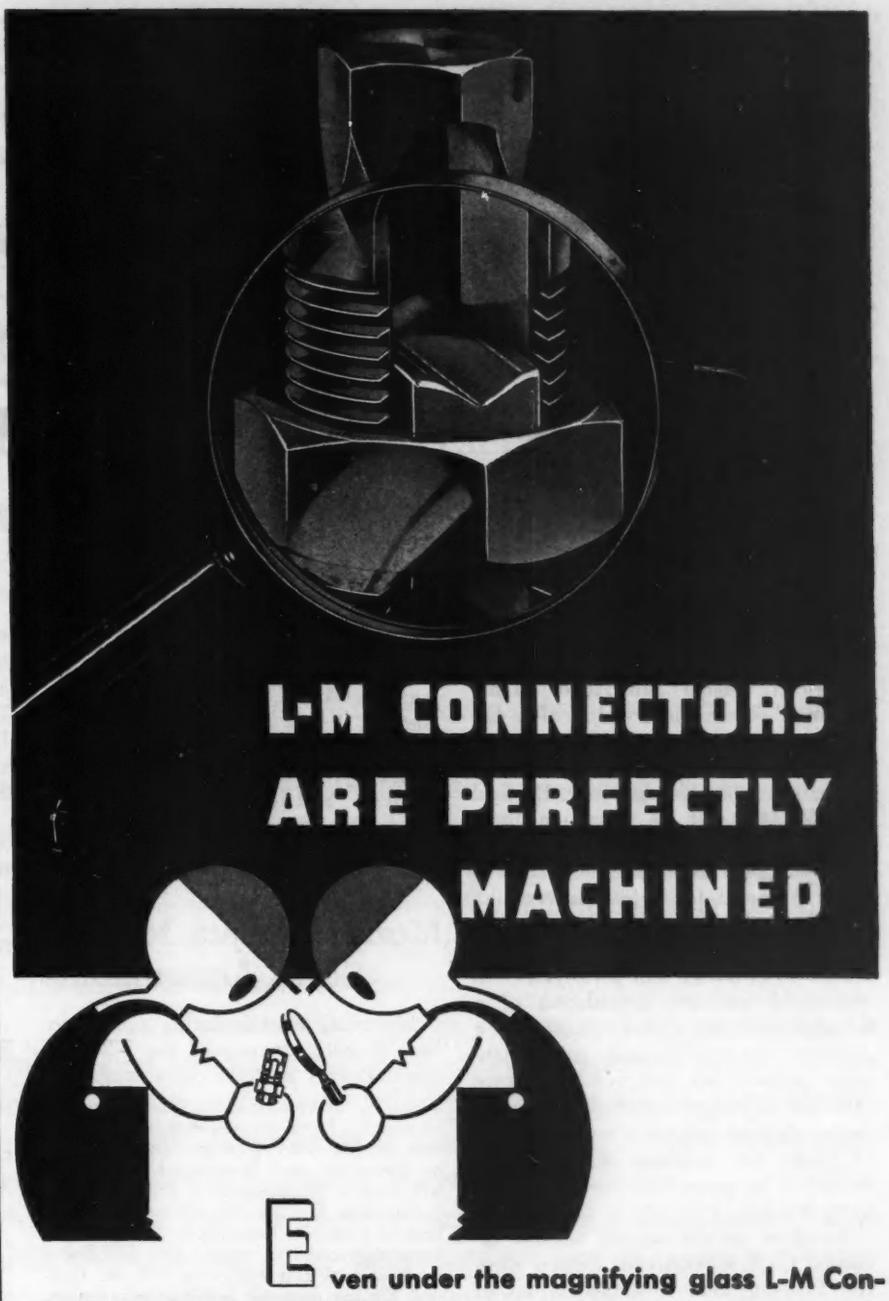
▶ALEXANDER A. CHISHOLM, retired superintendent, electrical distribution, Yonkers Electric Light & Power Co., Yonkers, N. Y., died at his home in that city November 23, after a long illness. He was 67 years of age. Mr. Chisholm had been in the Consolidated Edison system for forty years.

▶J. C. W. BECKHAM, chairman of the Kentucky Public Service Commission, commissioner of business regulation and former Governor and U. S. Senator, died January 9, at his home in Louisville.

▶PAUL HOOKER, brother of Harry M. Hooker, president of the Hooker Electrochemical Co., Niagara Falls, N. Y., died January 11, of a heart attack. He was 65 years old. Participating actively in the development of the company, Mr. Hooker had been an engineer at the plant 21 years.

▶PAUL J. OST, manager and chief engineer of the San Francisco Electric Power Bureau, a position he had held for several years, died in a San Francisco hospital, December 30. Among the more outstanding pieces of work for which he carried out the design is the city's 100,000-hp. Moccasin Creek hydro plant. Mr. Ost first entered the service of the city 30 years ago, and in addition to work on the electric system contributed much to the engineering work of the municipal railway and other public utilities. His death followed four days' illness.

▶GEORGE W. OLMSTED, vice-president and director of the Long Island Lighting Co., died January 15 at his home in Ludlow, Pa., in his sixty-sixth year. He had been in poor health for years. Mr. Olmsted was one of the founders of the Long Island Lighting System, having joined with Ellis L. Phillips in its organization about 30 years ago. In addition to his position with the Long Island Lighting Co. Mr. Olmsted was president of the Delaware Olmsted Co. and the United Gas & Electric Corp. and vice-president of the Eastern Seaboard Securities Corp., the Empire Power Corp. and the Kings County (N. Y.) Lighting Co. Mr. Olmsted was a member of the executive committee of the Empire State Gas and Electric Association.



Even under the magnifying glass L-M Connector threads are clean-cut, contact surfaces are smooth. This careful, near-perfect machining means better contacts, maximum pressure between conductors at any given torque. It means, too, that nuts run smoothly on L-M Connectors.

You always get perfect contacts with L-M Connectors, even after years of repeat usage. Made of special high strength copper alloy, they resist corrosion, refuse to yield under highest service pressures. Ask your L-M representative to show you samples of the complete L-M Connector line.

LM

LINE MATERIAL CO.

MANUFACTURING - MARKETS

Washer-Ironer Sales Set at $125,000,000

W. Neal Gallagher, head of the Automatic Washer Co. and just elected to his third term as president of the American Washer and Ironer Manufacturers' Association, stated after the recent annual meeting in Chicago that washer sales will total 1,550,000 and ironer sales 150,000 this year. He said $125,000,000 will be spent on these products.

On the association program for 1940 are a proposal for a joint advertising program underwritten by the members of the industry to promote certain standards of design and performance in household washers, formulation of a schedule of fair trade practices, a country-wide survey and sales managers' round-table designed to improve methods of compensation for laundering equipment salesmen and extension of plans for National Washer-Ironer Week, to be staged for the third time next October.

Speakers at the annual session included C. E. Greenwood, Edison Electric Institute, and Freeman Barnes of New York, who described the success of the I.E.S. lamp campaign. Simultaneously the association held its second National Washer-Ironer Show.

Other new officers include: R. D. Hunt, Dexter Co., Fairfield, Iowa; Oscar Lenna, Blackstone Manufacturing Co., Jamestown, N. Y., and W. K. Voss, Voss Bros. Manufacturing Co., Davenport, Iowa, vice-presidents, and Joseph R. Bohnen, Chicago, secretary-treasurer.

•

Business Advisory Group Names Batt Chairman

Business Advisory Council of the Department of Commerce has elected William L. Batt, president S.K.F. Industries, Philadelphia, to be its chairman for 1940. He succeeds W. A. Harriman, council chairman for the past three years. Mr. Harriman will remain on the council as a member of the executive committee.

At the conclusion of its two-day January meeting the council re-elected as vice-chairmen M. B. Folsom, Eastman Kodak Co., and Clarence Francis, General Foods Corp. Two new vice-chairmen also were elected, Harvey Couch, president Arkansas Power & Light Co., and John D. Biggers, Libbey-Owens-Ford Glass Co.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently announced the following appointments to their sales staffs:

W. N. Matthews Corp. has appointed Lyman C. Reed as representative for the sale of Matthews products in the states of Louisiana and Mississippi. Mr. Reed will have as his associate J. Fred Hamrick.

Virginian Electric Inc., located on Michigan Avenue in Charleston, W. Va., has been appointed a wholesale distributor in the Charleston wholesale area for General Electric domestic refrigeration, ranges, water heaters and kitchen equipment. It had previously been responsible for the distribution of the following products only, which are retained: G. E. cleaners, electric clocks, fans, heating devices, home laundry equipment, radios, insulating materials, Deltabeston wires and cables, wiring materials and automotive products.

Royal Electric Manufacturing Co., 619 East 40th Street, Chicago, Ill., has been appointed to represent W. A. Hesse & Co., Alameda, Calif., in selling the latter company's portable electroplating outfits through its various agents and connections in the U. S.

N. M. Mintz and Associates, 40th Street and Calumet Avenue, Chicago, Ill., will represent the Corning Glass Works in the northern parts of Illinois and Indiana, the southern and eastern parts of Wisconsin, and all of the state of Iowa. George Hamburger Co., 226 Cooper Bldg., Denver, Colo., will represent the company in the state of Colorado, eastern part of Wyoming and the western part of Nebraska. Both appointments cover the sale of "PYREX" brand radio and power insulators and line hardware.

Air Conditioning Orders Show Loss

Orders booked for air conditioning systems and equipment during November, as reported by 267 manufacturers, amounted to $7,189,794, as against $9,171,828 in October, according to the Department of Commerce. For the first eleven months such orders totaled $72,699,834.

On the previously maintained basis, including the reports of 125 manufacturers, orders booked during the first eleven months were $52,412,177, as against $36,984,432 in the corresponding period of 1938.

•

Keystone Steel Reports 52% Sales Increase

Keystone Steel & Wire Co. reports for the six months ended December 31, the first half of the company's fiscal year, net profit of $692,412 after all charges and federal taxes, equivalent to 91 cents a share on 757,632 shares of capital stock outstanding. This was about two and one-half times as large as net profit of $198,952 in the same period a year ago, which was equivalent to 26 cents a common share.

For the quarter ended December 31 net profit amounted to $418,489, equivalent to 55 cents a common share, compared with $115,728, or 15 cents a share, in the corresponding quarter of last year.

Sales for the six-month period totaled $6,549,109, against a total of $4,305,882 in the same period a year ago, a gain of 52 per cent.

•

Supply Contracts Let

American Steel & Wire Co. has received from the Navy Yard a contract for cable totaling $11,646. Announcement has been made that the War

WORTHINGTON

100 YEARS

1840 - 1940

"WHAT IS RIGHT WILL PROVE ITSELF RIGHT"

THUS WROTE Henry R. Worthington, a great engineer-inventor, in 1876. He continued, "I have asked for an answer to the question . . . Have I been able permanently to improve the department of engineering, in which I have steadily and exclusively worked?"

» Today, the company which he founded, its products in use in every country in the world, with plants that cover hundreds of acres, with the value of its manufactures reaching hundreds of millions of dollars, looks back over a century's span, and sees proved the essential soundness of its founder's vision and ideals.

» In its century of growth it has pioneered in many significant basic engineering developments of widespread application. Itself a pioneer, it has pushed forward shoulder to shoulder with pioneers, across continents and over the seven seas. It has witnessed the birth and growth of a new age. It has seen a whole new civilization develop, and has accepted the continued challenges of that civilization. Looking back on its rich and fruitful past, it turns to its second century confident of its ability to carry on with the splendid spirit and vision of its founder.

» Worthington's maturity finds expression in a notable group of engineering products with standards of excellence and records of performance unsurpassed in their respective fields . . . for the petroleum industry in production, transportation and refining . . . for gas and oil pipe lines and distribution . . . for refrigeration and air conditioning in every branch . . . for steam power, land and marine, including turbines, condensers, feedwater heaters and auxiliaries . . . feedwater heaters for railway locomotives . . . Diesel and gas engine units covering a wide power range . . . air and gas compressors for all industrial uses . . . a comprehensive line of contractor equipment . . . and pumping equipment whose scope is the most extensive available.

» It has been said that an institution is the lengthened shadow of a man. Perhaps more true of the Worthington Pump and Machinery Corporation than of most institutions, it yet is not the whole truth. This corporation is not only the lengthened shadow of one man, but of many men who have given the best of their keen minds and stout hearts, that their science and engineering could better serve not only their company but also the civilization of which they and it have been such important parts.

Harry G. Beaver

PRESIDENT

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

Moore Steam Turbine Division . . . Carbondale Air Conditioning and Refrigeration Division
Worthington-Gamon Meter Company

MID-1

Department has awarded to the American Transformer Co. a contract for transformers, amounting to $10,760.

•

Wiremold Enlarges Plant

Work has begun on the foundations for a new manufacturing unit for the Wiremold Co. at Hartford, Conn., to cost approximately $100,000. The new structure will be one story in height, 125 x 240 ft., and mainly of steel and glass with a monitor top. A wing 54 ft. long is included to tie the new plant into the existing factory, and a boiler house will form a part of the new work, the latter building being 28 ft. x 52 ft. Included in the shop equipment will be a 5-ton crane and a monorail installation. The new unit will fit into the straight-line production layout used generally by the company. The R. F. Jones Co., Hartford, is the general contractor and the architect, J. DeStasio & Co., New York. D. Hayes Murphy is president of the Wiremold organization.

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Electric Truck Shipments

Domestic shipments of electric industrial trucks and tractors during 1939 numbered 912 (total shipments, 1,079), as against 672 in 1938 (total, 842), according to the Department of Commerce.

•

Oil Burner Shipments

Domestic shipments of oil burners during November numbered 19,798, as against 34,264 in October and 11,173 in November, 1938, according to the Department of Commerce. For the first eleven months of 1939 domestic shipments totaled 197,075, as compared with 126,079 in the corresponding period of 1938.

•

Views 1940 with Optimism

H. G. Perkins, executive vice-president of the Nash-Kelvinator Corp., told stockholders at the recent annual meeting that the outlook of the company for the coming year was encouraging.

New York Metal Prices

	Jan. 23, '40 Cents per Pound	Jan. 17, '40 Cents per Pound
Copper, electrolytic	12.00*	12.50*
Lead, A. S. & R. price	5.50	5.50
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc, Spot	5.89	6.14
Tin, Straits	45.25	47.00
Aluminum, 99 per cent	20.00	20.00

*Delivered Connecticut Valley.

Field Reports on Business

The trend in business during early spring will depend much on the swings in Congressional sentiment. However, it is believed that a genuine upswing will get under way in the spring. Utilities report rising earnings, partially aided by continued cold weather.

NEW ENGLAND

Electrical equipment sales for last week moved ahead of the corresponding week a year ago. As compared with the pre-holiday buying of last month, there is some slackening, due principally to seasonal circumstances. Negotiations for power generation expansion on a considerable scale are engaging the attention of engineers in this area; at present more than 150,000 kw. additional energy is under consideration; of this amount nearly one-half is concerned with increases in plant capacities in this area. The 12,500-kw. turbo-generator bought by the Central Maine Power Co. for its Bucksport, Me., station will be shipped by G.E. shortly and installation will be effected as speedily as possible.

During the past week motor sales were limited to small lots and single orders. Typical items noted were a lot aggregating 60 hp. for a shoe factory, a number of 5-hp. motors ordered for textile service, two larger motors for a paper company and a fair-sized volume of fractional motors.

Floodlighting for the new Revere, Mass., municipal stadium is being considered. Firestone & Latex Products Co., Fall River, Mass., will add 100 employees for a new manufacturing process for producing battery separators.

Records set up by Vermont central stations include 2,666 sales of refrigerators, 722 ranges and 93 water heaters.

PACIFIC COAST

The value of 1939 building permits in seven Western states totaled $30,889,669, a 12 per cent increase over 1938, a 22 per cent increase over 1937 and the highest total since 1929.

Manufacturers report heavy buying by various sections of the California Central Valley project, such as two G. E. Diesel electric locomotives, value $70,000, and geared derrick and hoist motors, value $30,000, for Friant Dam and additional machinery, value $75,000, for the 10-mile aggregate conveyor for Shasta Dam; 5,000 men are now employed at this project. Alaska business, normally served chiefly by the Pacific Northwest, is very good, the nucleus being public structures at Sitka and Wrangell, projects air bases at Kodiak, Fairbanks and Darby, a record gold outpost last year. The Hawaiian Islands, served chiefly from California, report several public buildings in Honolulu and Hilo, much army and navy base construction at Hickam Field and Pearl Harbor and increased all-round business radiating from it.

Recent contracts throughout the West include $34,508 for wiring the new machine shop at Mare Island navy yard; $76,420 to Westinghouse for a 6,000-kva. generator and $69,720 to Baldwin Southwark for a 7,000-hp. turbine and governor, the set being the seventh unit for Minidoka project in Idaho; 1,000 poles, sizes 25 to 35 ft. for U. S. forest service near Redding; $84,000 for step-voltage regulators, switches and equipment for three Colorado Big Thompson substations, and switchgear units, value $46,000, and No. 4 size 3,333-kva. generators for Glendale. San Francisco is considering purchase of from 10 to 25 single-deck transit coaches, low bid being $7,691 each, from A.C.F. Motors Company.

NEW YORK

The drop in copper prices this week has failed to stimulate consumer demand and it is expected that producers may restrict output in the near future. Leading producers cut prices to 12 cents a pound, a drop of ½-cent from the price set October 5, last. Weaker prices prevailed for other metals.

Reduction in inventory stocks during recent weeks is expected to lift the volume of replacement buying, especially in early spring lines of retailers. The continued cold weather has been a factor in stimulating sales. Department store sales show a 9 per cent gain.

Refrigerator manufacturers are considering a move to reduce prices on 1940 models to meet the recent sharp cut by Kelvinator. Consolidated Edison is planning a six-month sales drive on refrigerators in co-operation with dealers.

The domestic situation continues to remain in a state of some uncertainty, especially the tax situation. The economy wave in Congress may not get as far as had been hoped. Slowing up of forward orders is expected to give way soon to a revival of activity. Optimism continues to prevail, although business indices show a falling off in business. Utilities see higher earnings.

CHICAGO

The severe cold wave this past week proved highly beneficial to many lines of business. Retail trade in this area rose from 10 to 20 per cent above the comparable week last year. Electrical power output rose 5,560,000 kw.-hr. over the previous week to a level 11.5 per cent above a year ago. Attendance at the Home Furnishing Market broke all records during the second week and showed a substantial increase in buying.

Industrial activity maintained a steady pace, with production substantially ahead of a year ago. New orders in the heavy equipment field have fallen behind current shipments, but the backlog is sufficient to sustain the high operating level for a considerable period. Sales of electrical apparatus continued to move forward at a relatively high rate. Sizable orders are being placed by utilities and industrial plants. Lighting equipment sales show a substantial increase over a year ago, while electrical appliances are moving especially well.

The city has ordered 650 steel line poles and has requested bids on 534,000 ft. of various sizes of rubber-insulated, lead-sheathed electric light cable, 20,000 ft. of 600-volt ten-conductor signal and power cable and 98,000 ft. of four, eight and twelve conductor feeder cable. Proposals were also requested on 111,000 ft. of 3½-in. fiber conduit.

REA Allots Funds; New Contracts Let

Allotments totaling $322,000 for the establishment of two new rural electrification systems in Oregon and New Mexico and enlargement of five others in California, Indiana, Minnesota and South Carolina have been announced by Harry Slattery, Administrator of Rural Electrification.

These allotments will finance construction of about 265 miles of new lines and other facilities to provide service for approximately 1,150 farm families in these states.

The Oregon allotment was made to the Malheur Co-operative Electric Assn. at Willowcreek, Ore., the second complete self-help project approved by REA. Under the self-help plan each member has the opportunity of earning money to be applied on the cost of house-wiring and appliances.

Details of these allotments follow:

CALIFORNIA—Mountain Empire Electric Co-operative, Inc., Campo, L. N. Miller, supt., $35,000 to increase facilities of the project to serve 115 additional members.

INDIANA—Southeastern Indiana REMC, Osgood, Jesse Owen, supervisor, $25,000 to purchase poles.

MINNESOTA—Douglas County Co-operative Light and Power Assn., Alexandria, Clifford R. Hove, supt., $20,000 to construct extensions to connect some 200 members along existing lines of the project. Stevens Big Stone Co-operative Power Assn., Benson, Victor Hanson, supt., $30,000 to construct 42 miles of line, 105 members in Swift, Pope and Stevens counties.

NEW MEXICO—Otero County Electric Co-operative, Inc., Cloudcroft, Ray Daniels, president, $80,000 to build 76 miles of line, 341 members in Otero and Chavis counties.

OREGON—Malheur Co-operative Electric Assn., Willowcreek, C. S. Harris, secretary, $108,000 to build 115 miles of line, 347 members in Malheur County.

SOUTH CAROLINA—Fairfield Electric Co-operative, Inc., Winnsboro, E. V. Lewis, supt., $24,000 to construct 34 miles of line, 71 members in Kershaw, Chester and Fairfield counties.

Earlier in the month allotments totaling $63,000 were made for enlargements of rural electrification systems in Florida, Iowa and South Carolina to provide service for approximately 275 farm families.

FLORIDA—Suwannee Valley Electric Co-operative Assn., Live Oak, $15,655 to complete first section of system and for construction of 14 additional miles, 48 members in Suwannee County.

IOWA—Glidden Rural Electric Co-operative, Glidden, $20,000 to connect 200 persons living adjacent to the lines and to restore an additional 13 miles originally deleted from the project.

SOUTH CAROLINA—Edisto Electric Co-operative, Bamberg, $22,000 to build 15 miles of line to tie the lines to those of the South Carolina State Rural Electrification Authority and to complete the original project.

CUT THE COST OF CONDUIT BENDING AND PIPE PUSHING

With Greenlee Hydraulic Tools

Hydraulic Conduit and Pipe Benders

Much time and money can be saved by using Greenlee Hydraulic Tools for bending conduit and pipe. Not only do they do the work faster, but they make a better job of it with much less effort on the part of the workmen. They are simple to operate and easy to take to the job. No. 770, shown to the right, bends all sizes of conduit from 1¼" to 3". The larger size, No. 775, bends all sizes from 3" to 4½". Attachments can be furnished for thin-wall steel conduit.

Ask Now for COMPLETE DETAILS

Hydraulic Pipe Pusher

With this hydraulic pusher, one man can stand in a comfortable position and send pipe under streets, sidewalks, lawns, etc., simply by pumping the handles. It saves money and makes it unnecessary to do extensive trenching. Because of its compact design and simple construction, it is easy to set up and move about. Capacity for pipe up to 4".

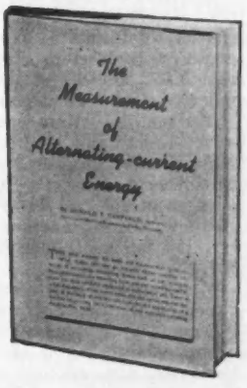
GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

A book for metermen— telling how to measure with the induction watt-hour meter

This practical book answers for metermen the following questions:

1. What makes the disk in a meter go around?
3. How can this revolving disk be made to measure energy?
3. What metering scheme should one use to measure the energy in a particular circuit?
4. How may one be sure that all the energy in such a circuit is metered by the particular scheme chosen?

The presentation is based throughout on the author's wide experience with classes of metermen.



Measurement of Alternating Current Energy

By DONALD T. CANFIELD
Associate Professor of Electrical Engineering, Purdue University

THE book begins with an outline of the development of the principles of metering. It then provides an answer to the question: What are the ways and means, together with their modifications, of producing a torque on a rotatable member by electromagnetic means?

After showing the possibilities of producing rotation in a disk by electromagnetic means, it explains why such motion must have a purpose.

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Construction contracts:

ARIZONA—Sulphur Springs Valley Electric Co-operative, Inc., Wilcox, M. M. Bennett, supt., and Stanley Engineering Co., Muscatine, Iowa, engineer, contract to H. H. Walker, Los Angeles, Calif., entire project, 259 miles of line, 546 members; bid $195,891.

COLORADO—Southeast Colorado Power Assn., Lamar, E. G. Rash, La Junta, supt., and Glenn R. Fickel, Denver, engineer, contract to E. A. Reither, Aitken, Minn., two more sections, 210 miles of line, 591 members; bid $144,909.

GEORGIA—Lamar Electric Membership Corp., Barnesville, Walter Y. Andrews, supt., and J. B. McCrary Engineering Corp., Atlanta, engineer, contract to Roy Richards, Carrollton, Georgia, another section of project, 213 miles of line, 486 members; bid $115,811.

ILLINOIS—Coles-Moultrie Electric Co-operative, Mattoon, John G. Waggoner, supt., and George D. Simpson, Quincy, Ill., engineer, contract to A. S. Schulman Electric Co., Chicago, another section of project, 215 miles of line, 461 members; bid $141,238.

INDIANA—Tipmont Rural Electric Membership Corp., Linden, Verl H. Hiatt, supt., and Putnam and Woolpert, Dayton, Ohio, engineer, contract to Honold and LePage, Sheboygan, Wis., another section of project, 561 miles of line, 1,580 members; bid $394,459.

IOWA—Marshall County Rural Electric Co-operative, Marshalltown, Harry H. Frey, supt., and Stanley Engineering Co., Muscatine, engineer, contract to Ferguson Diehl Construction Co., Jefferson, another section of project, 211 miles of line, 403 members; bid $136,109.

KENTUCKY—Fleming-Mason Rural Electric Co-operative Corp., Flemingsburg, James K. Smith, supt., and Ray W. Chanaberry, Louisville, engineer, contract to the Killoren Electric Co., Appleton, Wis., another section of project, 158 miles of line, 434 members; bid $101,423.

LOUISIANA—Southwest Louisiana Electric Membership Corp., Lafayette, H. B. Bowles, supt., and U. G. Gajan, Lafayette, engineer, contract to Stuart C. Irby, Jackson, Miss., another section of project, 124 miles of line, 292 members; bid $58,044.

MINNESOTA—Minnesota Valley Co-operative Light and Power Assn., Granite Falls, O. W. Swanson, supt., and United Engineering Service, Minneapolis, engineer, contract to the Franzen Brothers, Palisade, Minn., another section of project, 118 miles of line, 203 members; bid $81,229.

MISSISSIPPI—Delta Electric Power Assn., Greenwood, R. F. Harrison, supt., and Bowman & Bowman, Greenwood, engineers, contract to W. L. Coston & Sons, Bessemer, Ala., another section of project, 254 miles of line, 1,050 members; bid $124,227.

NEW HAMPSHIRE—New Hampshire Electric Co-operative, Inc., Concord, L. M. Huntress, supt., and J. R. Worcester & Co., Boston, Mass., engineers, contract to the Midland Constructors, Inc., Chicago, first section of project, 112 miles of line, 318 members; bid $80,094.

NORTH CAROLINA — Rutherford Rural Electric Mutual Assn., Inc., Forest City, D. B. Crow, supt., and B. O. Vannert, Charlotte, N. C., engineer, contract to Day & Zimmermann, Inc., Philadelphia, Pa., another section of project, 280 miles of line, 882 members; bid $156,014.

OHIO—Logan County Co-operative Power and Light Assn., Inc., Bellefontaine, E. W. Garling, supt., and Putnam and Woolpert, Dayton, Ohio, engineers, contract to Kelso-Wagner Co., another section of project, 153 miles of line, 391 members; bid $91,103.

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Recent Rate Changes

CONNECTICUT LIGHT & POWER CO. has reduced its commercial rates in Bristol, Plainville, New Britain and Norwalk, effective January 1. The cut will save consumers $185,000 annually in the Bristol district alone.

TRINIDAD ELECTRIC TRANSMISSION, RAILWAY & GAS CO. has reduced its electric rates in three southern Colorado cities, a score of coal mining camps and a wide rural area. The company has cut its domestic and commercial rates in Trinidad, Walsenburg and Aguilar 11 per cent. The reduction also applies to coal mining camps in Las Animas and Huerfano counties and to rural customers. These consumers will be saved approximately $32,000 a year as a result of the cut.

GLEN ROCK ELECTRIC LIGHT & POWER CO., Glen Rock, Pa., has filed tariff schedules effecting a reduction in gross annual revenues approximating $15,000. Domestic consumers share in more than half of the savings. The new rates became effective for all bills resulting from meter readings after January 15. The reduction is distributed among consumers as follows: domestic, $8,762; commercial, $3,456; small power, $1,868; street lighting, $1,051.

COMMUNITY PUBLIC SERVICE CO. has announced a voluntary rate reduction which will mean a saving of approximately $10,000 annually to customers of the company served from the Silver City, New Mexico, properties. The reduction applies to all domestic and commercial customers. The reduction will apply to the January billings.

MARSHFIELD ELECTRIC AND WATER DEPARTMENT, Marshfield, Wis., has made annual reductions of $20,000 in rates, effective on bills to be issued March 1. All classes of customers have benefited by the reduction. Residential customers are expected to save $7,700 annually; commercial light and power customers approximately $10,500 and rural customers about $1,800.

ILLINOIS COMMERCE COMMISSION has announced that rate changes in the state effective during the month of December resulted in a reduction in electric rates of $110,886. Electric rate reductions during the year 1939 totaled $2,980,071.

FALL RIVER ELECTRIC LIGHT CO. will put into effect February 1 rate reductions aggregating $300,000. New domestic prices are to be 6 cents per kilowatt-hour for the first 30 kw.-hr., 5 cents per kilowatt-hour for the next 50 kw.-hr., 3 cents per kilowatt-hour for the next 100 kw.-hr. and 2.5 cents for the excess per unit, with a minimum charge of $9 per year. General rates will also be reduced for commercial service and municipal service rates are to be cut about 11 per cent. The former domestic rates began with 6.5 cents per kilowatt-hour for the first 15.

WAKEFIELD, MASS., electric lighting department has announced a reduction of 1 cent per kilowatt-hour for all classifications of users, with an additional half-cent discount for prompt payment of bills.

THE Advertising PERFORMANCE OF Leading Companies (YEAR AFTER YEAR)

is Powerful Evidence That...

GOOD ADVERTISING *Pays* IN ELECTRICAL WORLD

Business men turn naturally and expectantly to the advertisements in the magazines of their industry to keep up to date on available products and services. They are constantly looking for down-to-earth facts. Companies which supply this sort of dependable and useful information in their advertising in Electrical World know that the results are well worth the advertising effort.

THE JAMES R. KEARNEY CORPORATION of St. Louis has come far, in a hurry. From the very beginning of its corporate life persistent, informative and forceful product advertising in ELECTRICAL WORLD has gone hand in hand with the sales force. This is how James R. Kearney, Jr., Executive Vice-President, explains it:

"The James R. Kearney Corporation began modestly in 1926 with a handful of men and a few carefully tested products which were the result of Mr. Kearney's active experience in the electrical field; one of the primary factors in the original organization plan of the business was a definite program of advertising.

"ELECTRICAL WORLD, one of the favorite publications of Mr. Kearney and his associates, was recognized then, as now, as one medium which served the operating men in the electrical transmission and distribution field in the capacity of current news of the industry as well as a purchasing guide.

"At no time since its beginning has the Kearney Corporation failed to recognize the necessity of using advertising space in business publications, along with other forms of advertising, as a vital factor in producing acceptance, creating good will and stimulating sales. In good times and in bad, it has been the policy of this company to tell by printed word, as well as by oral salesmanship, the functions, advantages, efficiency and economy of various Kearney products."

THE CONTINENTAL-DIAMOND FIBRE COMPANY of Philadelphia may rightfully claim a commanding position in the important field of electrical insulation; and, as is true with nearly all successful companies, publication advertising has played a conspicuous part. In the words of Nelson W. Sieber, Advertising Manager, we again find ELECTRICAL WORLD taking a lead role:

"To make a long story short, after making surveys both by mail, directly with our customers and prospects and through our sales force, we always found ELECTRICAL WORLD *to be preferred and to be read in every branch of the industry and by every type of individual that we were interested in reaching. Naturally, therefore, we depend on* ELECTRICAL WORLD *to carry the burden of getting our story to the electrical industry as a whole, and that is why we have consistently advertised in it year after year and have always tried to present our message in an effective manner and in keeping with our leadership in the insulating branch of the electrical industry."*

Many and varied are the idea as to what constitutes good advertising performance. Running through successful campaigns in Electrical World is a common denominator worthy of note: A consistent schedule of thoroughly informative copy . . . so presented that the reader has something upon which to act.

ELECTRICAL WORLD

Serving a Huge and Ever-Growing Market

A McGraw-Hill Publication, 330 W. 42nd St., N.Y.C.

No. 4 of a series of factual messages designed to demonstrate that GOOD ADVERTISING *in a leading business publication will invariably produce worth-while sales results*

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FARGO "6000" CONNECTORS

Distortion-proof Fargo "6000" Connectors retain their streamlined "figger" and bulldog grip under highest service pressures. They're built for repeat use . . . handle as easily, grip as firmly after years of service as the day you take them out of the carton. Specify Fargo "6000" in your next connector order, you'll use them over and over again. No. 6 and No. 4 now available; additional sizes at a later date.

MADE BY FARGO MFG. CO.
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LINE MATERIAL CO.

Sales Opportunities

RICHLANDS, VA.—Appalachian Electric Power Co., Roanoke, Va., plans new power substation in Hankins Bottoms district, Richland, where site recently has been selected, to be used for power supply for town requirements, as well as for several industrial plants in that area. Extensions will be made in transmission lines for connection with new station. Work is scheduled to begin soon.

CEDAR RAPIDS, IOWA—Central States Electric Co., Cedar Rapids, plans extensions in primary and secondary lines in parts of Hamilton County, totaling about 108 miles, for expansion in rural electric system, including power substation and service facilities. Permission has been secured.

LOUISVILLE, KY.—Louisville Gas & Electric Co. has plans maturing for new power substation in southern part of city, where site is now being secured, to be equipped for initial capacity of close to 20,000 kw. Cost estimated at approximately $125,000, including transmission line extensions to site. This will comprise part of 1940 substation expansion and improvement program of company, covering extensions in number of existing substation units, with installation of transformers, switchgear and auxiliary equipment, several new substations, including two or more of unit automatic type. Appropriation for this work will approximate $570,000.

COLUMBUS, OHIO—Columbus & Southern Ohio Electric Co., Columbus, is arranging fund of about $200,000 for extensions and improvements in steam-electric generating stations, including installation of equipment. Work will be carried out during 1940. Company also will make an appropriation of approximately $866,000 for new power substations and expansion and improvements in present substations, and for extensions in distributing lines in different districts during the year, including a number of new lines in rural areas.

PORTSMOUTH, VA.—Public Works Officer, Norfolk Navy Yard, Portsmouth, receives bids (no closing date stated) for one 6000-kw. turbo-alternator and accessories, for installation in central power plant at local yard (Specifications 9530).

BELDEN, NEB.—Loup River Public Power District, 2307 Thirteenth Street, Columbus, Neb., will build new power substation on site near Belden for stepdown service, with initial capacity of 2000-kva. Transmission line will be extended from Winside, Neb., to new station, about 16½ miles. Harza Engineering Company, 205 West Wacker Drive, Chicago, Ill., is consulting engineer.

WASHINGTON, D. C.—Potomac Electric Power Co., Washington, plans four new power substations, of which two will be for main 33,000-volt transmission system, with installation to include transformers with gross capacity of 140,000-kv., quantity of 13.2-kv. switching equipment and auxiliary apparatus; project will include construction of about 15 miles of 33,000-volt power lines for station connections and other service. Two power substations, noted, will be for main distribution line service, with gross capacity of about 16,000-kva. In addition, it is proposed to construct four smaller power substations for distribution service in main areas, each with a rating of 1000-kva. This will form part of 1940 expansion and improvement program of company.

RANKIN, PA.—Carnegie-Illinois Steel Corp., Carnegie Building, Pittsburgh, Pa., will complete plans early in spring for proposed new steam-electric generating station at Carrie blast furnace properties, Rankin, previously referred to in these columns. Plant will be equipped for initial capacity of 32,000 kw. and will be used, as well, for power supply for other mills of company in the Monongahela Valley district. Cost estimated over $500,000, with turbine-generator unit, high-pressure boilers with capacity of 450,000 lb. of steam per hour, and auxiliary equipment. Stone & Webster Engineering Corporation, 49 Federal Street, Boston, Mass., is consulting engineer for design of station and will supervise construction. Completion is scheduled in the fall.

EUGENE, ORE.—Water Board, J. W. McArthur, superintendent, will have plans prepared at once for new steam-electric municipal power station, with capacity of 7,500 kw., to be used for standby service in conjunction with present municipal hydroelectric generating station. Fund of $510,000 is being arranged for project, which is scheduled to be carried out this year.

PHOENIX, ARIZ.—Bureau of Reclamation, Denver, Colo., has secured an appropriation of $1,500,000 for construction of transmission lines for the Gila River Project, Arizona, including switching station facilities. A considerable part of program will be carried out in 1940. Bids will be called as different sections of project mature.

JOHNSTOWN, PA.—Bethlehem Steel Co., South Bethlehem, Pa., plans installation of motors and controls, conveyors, electric traveling cranes and hoists, loaders and other equipment in new one-story addition, 220 x 250 feet, to Cambria mill, Johnstown, for expansion in storage and distribution department of wire works. Cost close to $175,000. W. C. Frank is chief engineer at Johnstown.

PUEBLO, COLO.—Southern Colorado Power Co., Pueblo, plans expansion and improvements in local steam-electric generating station, with installation of equipment to double, approximately, present capacity. Work will include switchyard and transmission line extensions. Cost estimated close to $1,000,000. Proposed to carry out project during present year.

PORTLAND, ORE.—Administrator, Bonneville Project, Department of Interior, 811 N.E. Oregon Street, Portland, receives bids until February 10 for conductor cable and accessories for 115-kv. transmission lines for Bonneville system between Yakima and Ellensburg, Wash. (Circular 727); also, until February 12, for construction of power substation unit, including underground piping, etc., near Raymond, Wash. (Circular 728).

READING, PA.—Metropolitan Edison Co., Reading, has plans in progress for expansion and improvements in steam-electric generating plants at Reading and Lebanon, Pa., with installation of turbine-generator units, high-pressure boilers and auxiliary equipment for large increased capacity. Cost estimated about $3,500,000. This will be part of 1940 expansion and modernization program of company.

CENTERVILLE, OHIO—Iowa Southern Utilities Co., Centerville, plans extensions in primary and secondary lines in parts of Henry and Washington Counties for expansion in rural electric system, including service facilities. Application has been made for permission.

Reduce
Line Clearing
Costs
with
Seymour
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TELEPHONE PRUNERS
This powerful pruner cuts closer, is stronger than any other similar tool on the market. Can be operated in close tangled growth; cutting easily and cleanly branches up to 1½" in diameter. No trouble with spring breakage.
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INDIANA STEEL & WIRE CO.
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Crapo Galvanized Strand and Telephone Wire can be obtained readily in all standard grades and sizes.

17 Systems Report Smooth Capacitor Performance

[*Continued from page 41*]

ods of minimizing the interfering effects of capacitors, and that where required there appear to be available a number of possible and practical methods of solution.

A company which reported excessive 5th-harmonic current reported no telephone interference resulting from the capacitors.

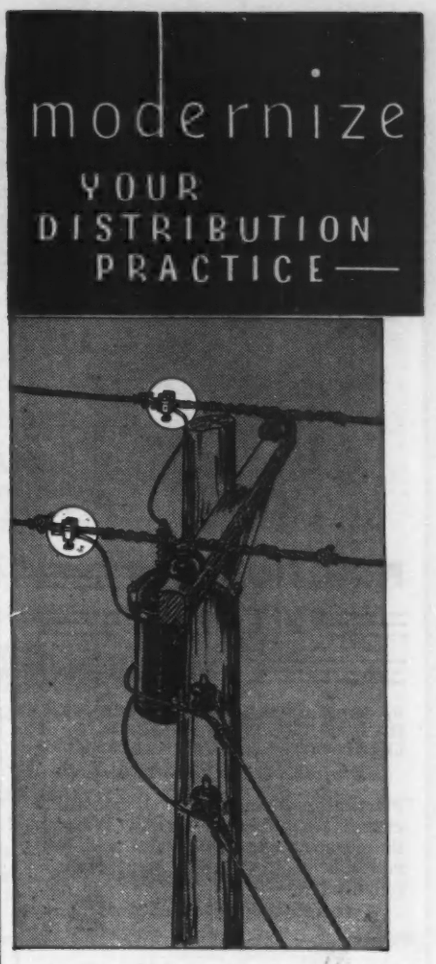
On one system with capacitor installations at the ends of single-phase, 2,300-volt, common-neutral primaries considerable noise appeared on telephone party lines where the low impedance, single-condenser sub-sets were used. The interference was reduced by moving the capacitors back to the end of the three-phase primary, where they were installed in three-phase, wye-connected banks.

Capacitor Benefits Confirmed

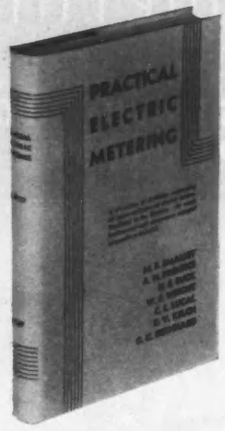
Justification for capacitor installations seems to be about equally divided between voltage improvement and load relief. Whichever objective happens to be the primary motive, the other objective usually attains nearly equal importance. The following cases show certain specific intentions and corresponding results:

1. One company reported installation of capacitors on 4,000-volt circuits to accomplish two purposes: The generators at one station could not generate at full capacity due to low power factor, and some overhead lines and substations were overloaded due to load current and wattless. In 1937 capacitors totaling 3,060 kva. were installed. This raised the power factor from 78 per cent to 90 per cent lagging. A further study showed need for additional capacitors and 3,000 kva. were installed during 1938. This raised the power factor to 99 per cent lagging. The power factor was raised higher than would have been done normally, due to additional benefits, by making it possible for the generators to put out more kilowatt-hours. During the time of the year when the load is of such character that this large amount of capacitors would result in a leading power factor a sufficient quantity is cut out of service to give a lagging power factor of approximately 90 per cent.

2. While load relief was reported to be the principal reason for the use of capacitors in one city, where all


modernize
YOUR
DISTRIBUTION
PRACTICE—
A C S R rural line transformer pole.
Connections made over armor rods.
Straight-thru dead ends of hard drawn copper secondary.
RELIABLE FLIP-ON TAP CLAMPS for ACSR over armor rods combine high strength with light weight and make fine mechanical and electrical joints. Very easy to install. Very low in cost.
Reliable
ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES

Designed for the use of the man in the field



PRACTICAL ELECTRIC METERING

By M. F. SMALLEY, A. N. PRENTICE, H. E. BUCK, W. J. WRIGHT, C. L. LUCAL, R. V. KELCH, G. K. BERNHARD

All of the Ohio Power Company

Practical metermen as well as utility electrical engineers, especially those in the metering and power sales field, will find this book valuable. Many features commend it —

- Prepared by men experienced in actual meter work in a power company;
- Simple and understandable, with not too technical language nor too difficult mathematics;
- Inclusive in treatment, for the principles set forth may be applied to all makes and types of meters;
- Reviews elementary electric theory as a basis for following the later discussion;
- Presents material on thermal demand meters which is not readily available elsewhere;
- Offers a simple, accessible development of trigonometry and tables in the appendix;
- Gives the essential details in its presentation of the theory, circuit diagrams and vector analysis of KWH, RKVAH and demand meters, and the current and potential transformers.

First and foremost, this book is practical. It discusses those phases of metering which you will actually use in your work. Send for an on approval copy and see for yourself.

Published January 1940

227 pages 226 illus. 6 by 9 $2.75

ON APPROVAL COUPON

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Kindly send me, on ten days' approval, a copy of SMALLEY et al: PRACTICAL ELECTRIC METERING. At the end of that time, if I decide to keep the book I will remit $2.75 plus postage; otherwise, I will return the book postpaid.

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EW-1-27-40

4,000-volt circuits are regulated, it has been found that with the combination of regulators and capacitors on a circuit the voltage conditions are highly satisfactory.

3. One company started a program to install about 6,000 kva. of capacitors at various points on its system in order to effect a reduction in wattless current; to release substation and regulator capacity, and in a number of cases to improve voltage conditions at several points furthest out on the feeders. It was found that, in general, the results of the applications worked out closely as anticipated, and in many cases, as the most economical method of making additional capacity available, or of relieving overloads.

4. A company on the Pacific Coast reported that the purpose of a large percentage of the 6,255 kva. of capacitors installed was to raise the voltage on 4,000-volt feeders.

5. Approximately 15,000 kva. of capacitors were installed on a system in a city in Texas, principally to reduce ampere loading on 4,000-volt feeders, substations, transmission equipment and generating equipment. The use of capacitors postponed the increasing of system capacity. At the time of the peak load (72,000 kva. on September 9, 1938), if the power factor had been down to 79 per cent as it was in 1936, the kva. would have been about 91,000. The capacitors reduced it to 83,000 kva.—an 8,000 kva. reduction, or 0.53 kva. for each kva. of capacitors.

6. Another company in Texas installed 8,550 kva. of capacitors on 2,300-volt and 4,000-volt circuits in one city. Tests were conducted to determine the resulting reductions in load. With 7,065 kva. connected, the kva. load was reduced by 3,460 and the total amperes reduced by 505. On that system the capacitors are operating at approximately 2,200 volts. This reduced the actual kva. of the capacitors by about 9 per cent below rated kva.

7. Results obtained by the installation of 555 kva. of capacitors on feeders served by a small substation are shown in an accompanying illustration. The kva. load was reduced from 1,150 to 750—a reduction of 400 kva., or 0.72 kva. for each kva. of capacitor rating. This ratio is high because these capacitors were operating at 2,500 volts; which increased the actual kva. drawn by the capacitors from 15 per unit to 17.7, making the total actually 655 in place of the rated kva. of 555. The chart shows the r.-kva. reduced by 690. The difference, 35 kva., can be accounted for by the reduced I^2X due to the lower current, which was reduced from 140 to 105 amp.

8. Capacitors totaling 1,980 kva. were installed by one company on an underground a.c. network system. The units were 2,300 volts and installed in wye-connected banks on the 4,000-volt feeders. The reduction in kva. and improvement in power factor is shown. At the time of the peak the kva. was reduced by 1,000 and the power factor raised from 78 per cent to 90 per cent lagging.

The installation of an additional 2,000 kva. is being considered, and although the power factor will be raised to nearly unity during light-load periods and about 97 per cent at time of peak, the investment may be economical. The kva. at peak would be reduced about 675, or 0.34 kva. for each capacitor kva.

9. One company, with more than 8,000 kva. installed, calculated that at the time of the peak load the reduction in I^2R on one 4,000-volt feeder amounted to 50 kw. This benefit frequently is not evaluated. It is difficult to measure as the voltage rise may result in an appreciable increase in kw. due to higher voltage taken by resistance loads connected.

Carrier Control Is Faster Than "Hunt Fault" Procedure

[*Continued from page 43*]

ures, three were chargeable to the short-circuited carrier phase, since increased in spacing. Two other failures resulted from the lightning stroke at Burns Corner. The remaining four were due to personnel errors, which have been corrected by further instruction to personnel.

The Bangor company's experience points to the need of (1) a better timing device on the check-back signal, and (2) greater spacing btween operating positions on the "Auto-Dial."

The check-back modulates the carrier wave with a high-pitched tone signal, to indicate the completion of a switching operation, duration of the tone signal being governed by an oil dashpot on the signal relay. As a result of the wide variations in tem-

perature under which the equipment operates, the timing of the tone signal has been known to vary from a few seconds to a matter of minutes, all within a single day. In extreme cold weather the relay has several times failed to complete its cycle. Since no other operation can be initiated until the signal relay and timer have completed their cycle, the danger of the installation becoming inoperative is apparent.

It is understood that a new timing device, independent of the influence of temperature changes, has been developed, and that it will be incorporated in the receiving sets within a short time.

The "Auto-Dial" is an adaptation of intercommunicating telephone equipment for purposes of switch control. In each operating position it will dial a four-digit code signal, calling for a specific operation at a distant station. It is fast, and it eliminates the possibility of dialing a wrong digit, but the operating positions are so close together that, under stress of emergency, the operator could easily signal for the wrong operation. Bangor Hydro engineers have advocated the development of a selector switch, with an indicator having a circular dial like an engine room telegraph, which will have fairly wide sectors, easy to read. If such a device is not forthcoming, other means of initiating the code signal must be employed.

In sum, at a very reasonable figure, the Bangor company has obtained a reliable and useful operating tool for speeding up restoration of service. The troubles experienced during the first sixteen months of operation have been no more than reasonably could have been expected in the pioneering of a comparatively new application. Carrier current has proved to be a reliable means of switch control and communication. It has a few limitations, but they are far outweighed by its advantages. In any case, it is much faster than the "hunt" system of locating line trouble.

•

$110,000 Welding Research

A $110,000 program of welding research will be carried out in 1940 by the Welding Research Committee of the Engineering Foundation, research organization of the national engineering societies.

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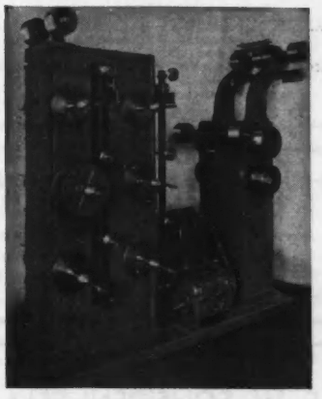

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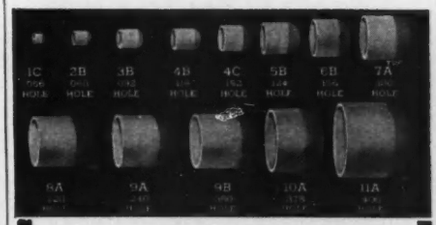
Municipal Plants

PARAGOULD, ARK. — Arkansas Utilities Co. has filed with the state Supreme Court an appeal from the Greene County Chancery Court decision dismissing a petition for an injunction against the municipal light plant. The utility company sought the injunction to restrain the municipal plant from extending its lines into a rural area surrounding the city. The company declared in its appeal that the Arkansas Utilities Commission had previously denied the city plant authority to extend its lines into the area and charged the extension would make the city a competitor "without warrant or authority of law," and added "there would be inflicted upon the plaintiff irreparable loss by way of permanent destruction of its business."

MIDDLESBORO, KY.—Sixth United States Circuit Court of Appeals has ruled against trustees of the Kentucky Utilities Co. in their appeal from a decision of the district court at Lexington denying them an injunction to restrain the city from forcing the utility company to remove wire and poles from that city. Suit for an injunction came after residents of Middlesboro voted November, 1936, to set up a municipal light, heat and power plant. In dismissing the bill the district court had held that the plaintiffs failed to "show that they have a lien on a perpetual franchise or right to use the streets and public ways of the city." Prior to the district court action the Kentucky Court of Appeals reversed a Circuit Court decision holding that the utility company did have a perpetual franchise.

EAST ROCHESTER, N. Y.—Voters last month approved a $300,000 bond issue for a municipal electric plant. The issue was carried by more than a 2 to 1 majority as 1,062 voted in favor against the opposition's 420. Taxpayers turned 580 "yes" votes against 246 "no." Non-taxpayers approved the plan by 482 to 174. The village is served by the Rochester Gas & Electric Corp.

FREDERICKSBURG, VA.—City Council has voted in favor of a municipal electric system as opposed to renewal of the franchise of the Virginia Electric & Power Co., which has been under consideration for more than three years. The present franchise under which the power company has operated for 30 years expired in March and since that time the utility system has continued its service while waiting for disposition of its franchise proposal. Members voted ten to one in favor of a municipal system.



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[*Continued from page 33*]

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•

REA Gives Summary of Year's Progress

About 1,700,000 farms, or 25 per cent of the total number in the United States, now have electric service, it is stated by Harry Slattery, REA Administrator, in a year-end summary of progress.

Of those 1,700,000 approximately 400,000 users, or somewhat under one-fourth, are estimated to be served from REA projects, an increase of 225,000 during the year. The total, it is pointed out, is well over twice the number, 743,954, having such service shortly before the REA was established in 1935, and the percentage of farms electrified has risen, as of January 1, from 10.9 to an estimated 25.

Of the present number of connections to REA lines 86 per cent are farms, 6 per cent are non-farm residences, and 8 per cent are commercial and industrial enterprises and public buildings.

Twenty-one co-operatives have grown to million-dollar size: the largest in funds is the Thumb Electric in Michigan with $2,050,000; in members receiving service, the Pioneer Electric in Ohio with 3,600 users; in length of line, the Pedernales in Texas, with 1,700 miles. The average size has an investment of $400,000 and serves 1,200 users from 400 miles of lines. Of REA borrowers 88.4 per cent are cooperative.

Of the total allotments of $273,000,000 less than 3 per cent have been used for the construction of 36 small generating plants, aggregating 26,500 kw., to cost $6,500,000.

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(Continued on opposite page)

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